Overview

MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)

What's New

The MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports) features:

- **Processor:** 2.3GHz dual-core Intel Core i5 processor or 2.5GHz dual-core Intel Core i7 processor

The MacBook Pro (13-inch, 2016, Two Thunderbolt 3 Ports) features:

- **Processor:** 2.0GHz dual-core Intel Core i5 processor or 2.4GHz dual-core Intel Core i7 processor

Both the 2016 and 2017 models feature:

- **Memory:** 8GB or 16GB on board, not user installable
- **Storage:** 128GB, 256GB, 512GB, or 1TB flash storage
- **Graphics:** Intel Iris Graphics 540

Diagnostics:

- Apple Service Toolkit version 2 (AST 2)
- Trackpad: The Trackpad Calibration Check must be performed after every repair.

For product configurations, refer to Tech Specs at support.apple.com/specs/#macbookpro.

Important Service Considerations

This computer model's design requires special service considerations:

- **Training:** This computer should only be repaired by Apple-certified technicians. For more information, refer to article

HT205332: About AppleCare service certifications.

- **Battery Service:** The battery is not a replaceable part. Never remove the battery from the top case. To replace a battery, you must replace the top case.
- **Battery Safety:** Before beginning any repair procedure, install the battery cover and disconnect the battery connector.
- **Top Case:** The top case includes the battery, BMU, keyboard, microphone, audio flex cable, trackpad flex cable, and trackpad. If the battery, keyboard, microphone, or trackpad must be replaced, you must replace the top case. Refer to article TP1538: Battery Handling and Storage.
- **2D Bar Codes:** This computer includes 2D bar codes that require service providers to have updated bar code scanners. It is important to upgrade scanners to read 2D bar codes in order to enter part serial numbers in GSX. For more information, refer to article OP53: Bar Code Scanner Information and Configurations.
- **Right and Left Speakers:** The right and left speakers are paired and only offered as a kit. If you need to replace one speaker, you must replace both. Do not save a used, good speaker for another repair. The speakers are fine-tuned to each other by the manufacturer and will not operate properly if mismatched.
- **Keycaps:** The keyboard has new glyphs on the Option and Control keys. Keycap kits for the 2017 model can be used on the 2016 model, but keycap kits for the 2016 model cannot be used on the 2017 model.

Starter Kits

- 076-00290 Bottom Case Removal/Installation Kit
- 923-01318 Battery Cover, package of two

Use Software Update

MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports) ships with a model-specific version of macOS. Refer to article HT204319: macOS versions and builds included with Mac computers to make sure the system build is correct for this computer model. Using Software Update, check for and apply the latest software and firmware updates.

Serial Number Locations

The system serial number and model number are located on the bottom case. Turn over the computer to view the numbers etched on the bottom case near the hinge.

Note: Bar code readers can be used to read serial numbers inside the computer. For information on the serial number format, refer to article OP51: Frequently Asked Questions and Answers Concerning Apple's New Serial Number Format .

Model and EMC Numbers

- MacBook Pro (13-inch, 2016, Two Thunderbolt 3 Ports): Model Number **A1708**; EMC number **2978**
- MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports): Model Number **A1708**; EMC number **3164**
- MacBook Pro (13-inch, 2016, Four Thunderbolt 3 Ports): Model Number **A1706**; EMC number **3071**
- MacBook Pro (13-inch, 2017, Four Thunderbolt 3 Ports): Model Number **A1706**; EMC number **3163**
- MacBook Pro (15-inch, 2016): Model number **A1707**; EMC number **3072**
- MacBook Pro (15-inch, 2017): Model number **A1707**; EMC number **3162**

Transferring the System Serial Number

When replacing a bottom case, retain the user's original bottom case until the repair is complete. Before installing **either** a replacement top case or bottom case, use a fine-tipped permanent marker to write the original system serial number inside the bottom case.

Battery Serial Number

Copy the original battery serial number when reporting a top case return to Apple.

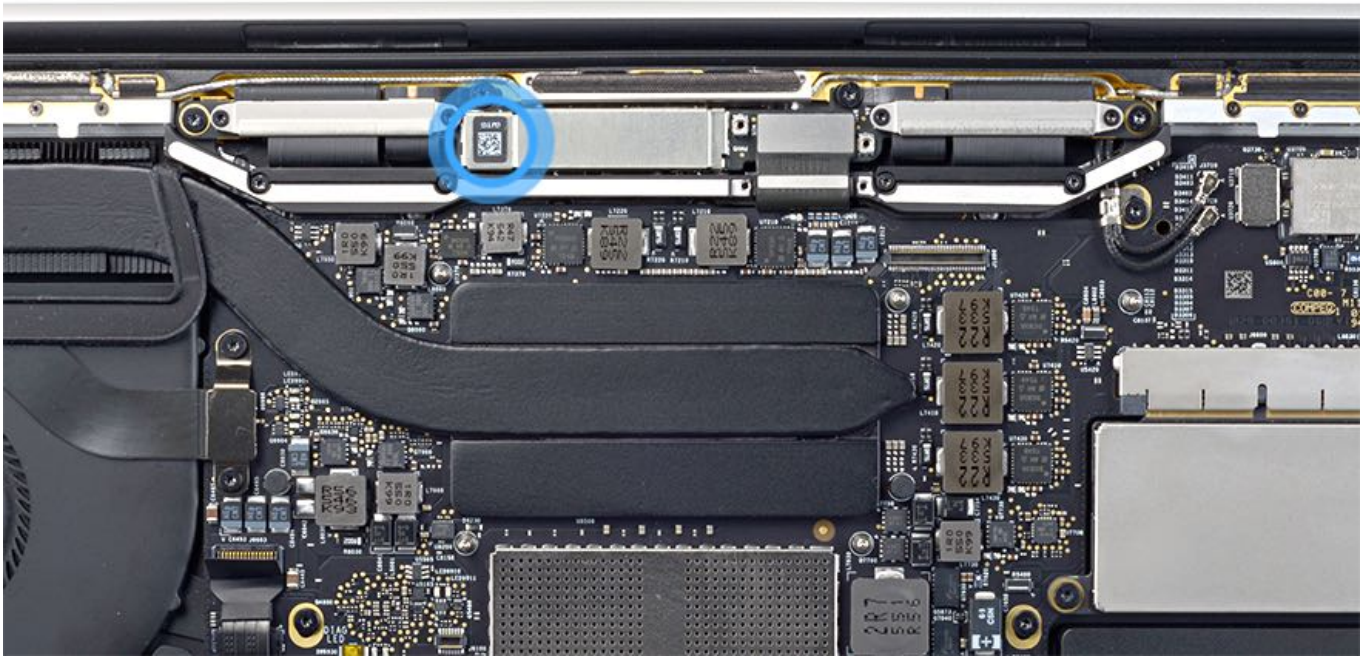
The MacBook Pro (13-inch, 2016 and 2017) battery serial number is located underneath the trackpad flex cable. Carefully peel back the trackpad flex cable to view the battery serial number.

The MacBook Pro (15-inch, 2016 and 2017) battery serial number is located on the BMU board.

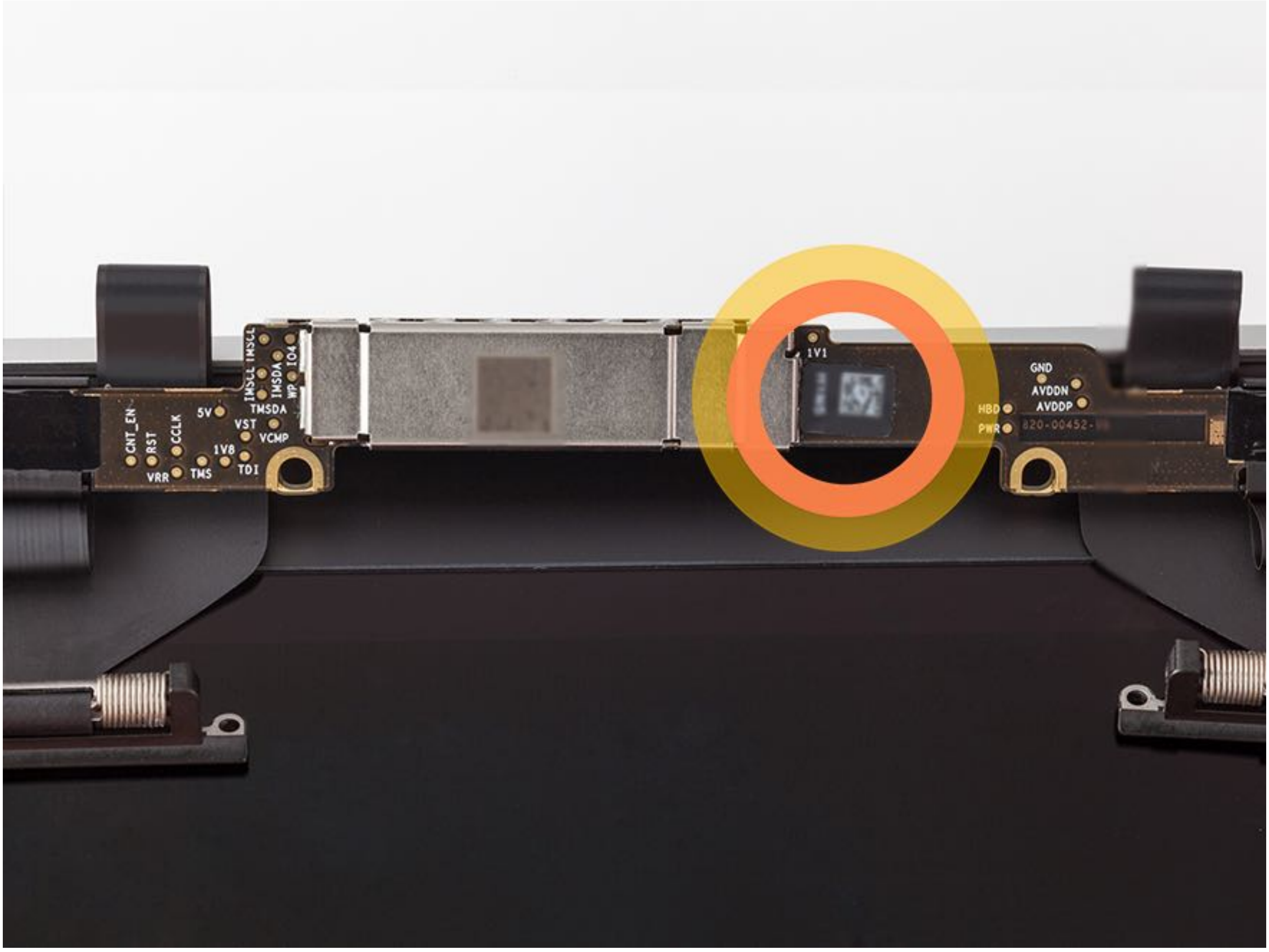
Display Assembly Serial Number

The display serial number is located on the TCON board.

The MacBook Pro (13-inch, 2016 and 2017) display serial number is shown below.



The MacBook Pro (15-inch, 2016 and 2017) display serial number is shown below.


CNT_EN
RST
CCLK
5V
VRR
TMS
1V8
TDI
VST
VCMP
TMSDA
IMSDA
WP
IO4
1V1
GND
AVDDN
AVDDP
HBD
PWR

Auto Boot

Auto Boot for MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017)

Boot on Lid Open and Boot on AC Attach are two features that automatically turn on the computer. These features must to be disabled prior to any repair that involves removing the bottom case. After the repair is complete, these features must be re-enabled.

Boot on Lid Open occurs when:

- the computer is shut down and you open the display to use the computer.
- the battery has enough power (otherwise the computer will show the battery charging icon).

Boot on AC Attach occurs when:

- the computer is shut down while the display is open, and then you plug in the AC power cord.
- the computer is shut down while the display is closed and an external monitor is attached, and then you plug in the AC power cord.

Important: Before you begin any repair, disable both features and unplug the computer for the duration of the repair. After the repair is complete, re-enable these features.

To disable both features before a repair:

1. Double click on the drive that contains the macOS.
2. Open the Applications folder.
3. Open the Utilities folder.
4. Double click on the Terminal application.
5. Type the following text EXACTLY as shown (the last two characters are zeroes):
    - **sudo nvram AutoBoot=%00**

To re-enable both features after a repair:

1. Double click on the drive that contains the macOS.
2. Open the Applications folder.
3. Open the Utilities folder.
4. Double click on the Terminal application.
5. Type the following text EXACTLY as shown (the second to last character is a zero):
    - **sudo nvram AutoBoot=%03**
6. Shut down the computer and close the display.
7. Open the display and verify that the computer turns on.

Data Migration

Data Migration on the MacBook Pro (2016 and 2017)

Use Migration Assistant or target disk mode to transfer data between MacBook Pro (2016 and 2017) with Thunderbolt 3 ports and other Macs.

To transfer data between a MacBook Pro (2016 and 2017) with Thunderbolt 3 ports and another Mac with Thunderbolt, connect a Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter to the MacBook Pro and use a Thunderbolt cable to connect the adapter to the other Mac. Then follow the steps for using Migration Assistant in target disk mode to move your files. For older models with FireWire connection, use the Thunderbolt to FireWire Adapter with a FireWire cable, then follow the steps for using Migration Assistant in target disk mode.

For more information on how to move content to a new Mac using Migration Assistant or target disk mode, refer to article HT204350: Move your content to a new Mac.

Tools:

- Belkin Thunderbolt 3 Cable (923-01131)

- Apple Thunderbolt Cable (661-6029)

- Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter (661-06668)

- Thunderbolt to FireWire Adapter (661-6585)

For further reference, refer to these articles:

- HT201853: About Apple video adapters and cables
- HT207266: Connect devices and displays with the Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter
- HT204360: Using USB-C and Thunderbolt 3 (USB-C) ports and adapters on your Mac notebook
- HT201163: Using USB 3 devices with Mac computers

Battery Safety Setup

Battery Safety Setup for MacBook and MacBook Pro (Mid 2012 and later)

Warning: Before servicing a MacBook or MacBook Pro computer, read and understand article OP24: Safely handling lithium batteries and lithium battery-powered devices.

For information on how to set up your workstation, refer to article OP685: About embedded battery safety.

Battery Handling and Storage

Battery Handling and Storage for MacBook Pro (2016 and 2017)

Best Practices

The battery contains several soft battery cells. Do not press on the battery cells with your fingers, and do not handle the battery pack in any way that might apply any physical pressure to these cells.

- Always attach the battery cover to the battery immediately after removing the bottom case and before beginning any repair. Make sure all four snaps on the battery cover are secure. Refer to the following list for battery cover part numbers:
  - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**
  - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**
  - MacBook Pro (15-inch, 2016 and 2017): **923-01320**
- Disconnect the battery cable from the logic board whenever the bottom case is removed. Keep the battery cable disconnected during all part removal and reassembly; reconnect it just before replacing the bottom case.
- Do not use a damaged battery cover. If the battery cover is damaged, replace it.
- Remove the battery cover just before replacing the computer's bottom case. Keep the battery cover on the battery at all other times.
- Do not drop a top case assembly with battery. If the top case has been dropped, replace it.

Battery Covers

MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**

MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**

MacBook Pro (15-inch, 2016 and 2017): **923-01320**

Battery Inspection

Refer to article OP693: Visual battery inspection for the latest visual inspection details.

Packaging a Top Case Assembly with Battery for Return

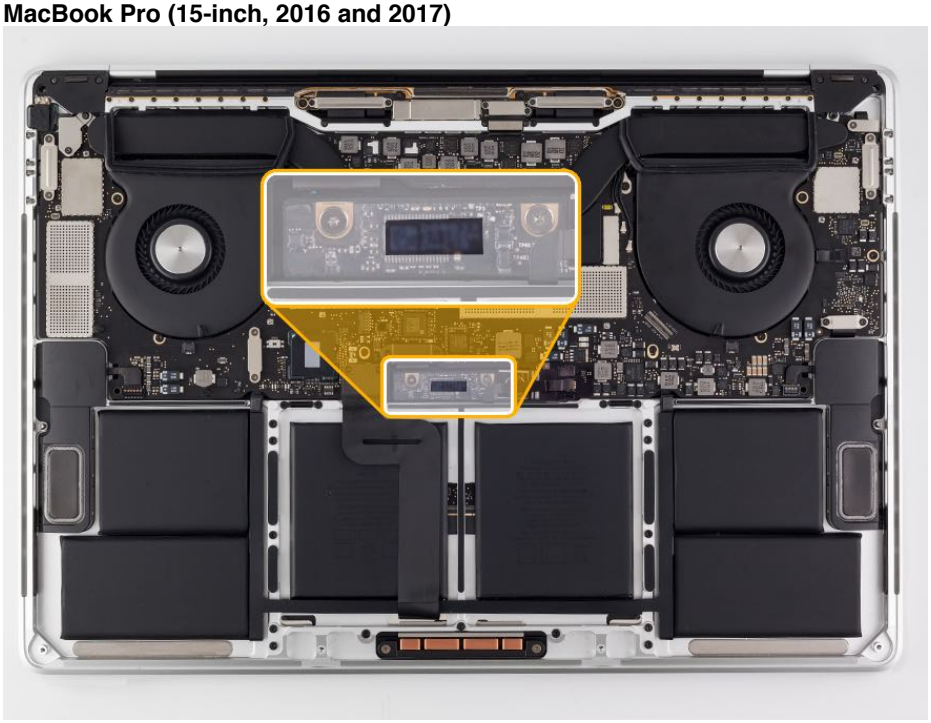
Important: Do not discard the top case packaging.

The same cardboard box and inner packaging used to ship a known-good top case assembly with battery must be used when returning it.

1. Verify that the packaging is in good condition; that labels are present, legible, and intact; and that the box is well-structured and strong.
2. If the box is in good condition but needs a packing list, print a new packing list from article HT204643: Prepare shipments of lithium batteries and battery-powered equipment.
3. If the box is in poor condition, order a replacement box kit (606-0104). The kit includes the outer cardboard box, foam frame, two foam pads, labels, and an ESD or plastic bag.
4. Reuse the protective battery cover from the original top case removal. If a new battery cover is needed, order part from the following list:
    - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**
    - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**
    - MacBook Pro (15-inch, 2016 and 2017): **923-01320**
5. Make sure the protective battery cover is securely attached to the battery. Install the battery cover as soon as the bottom case is removed and keep it in place for all subsequent part removals.
6. For MacBook Pro (13-inch, 2016 and 2017) models, the serial number is located on the battery. For the MacBook Pro (15-inch, 2016 and 2017) model, the serial number is located on the BMU board. Scan or copy the original battery serial number when reporting the return of the top case assembly with battery to Apple.

MacBook Pro (13-inch, 2016 and 2017)

MacBook Pro (15-inch, 2016 and 2017)



7. Place the top case with covered battery inside the bag.
8. Fold over the bag and seal it closed with the yellow ESD sticker. (If the sticker is not available, use tape.)
9. Place wrapped top case on bottom foam pad within inner foam frame inside cardboard box.
10. **Important:** When placing the wrapped top case into the box, make sure the battery is face up and at the front opening of the box.

10. 

11. Carefully place the second foam pad over the wrapped top case.

11. 

12. Close the box and seal it with tape. Do not use staples.

12. 

13. Make sure the Caution label and packing list are attached to the box.
14. Attach a shipping label and return the top case assembly with battery using normal shipping procedures.

14.


CAUTION
DO NOT LOAD OR TRANSPORT PACKAGE IF DAMAGED
PACKING LIST/INVOICE ENCLOSED

Butterfly Mechanism Keycap Replacement

Butterfly Mechanism Keycap Replacement MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017)

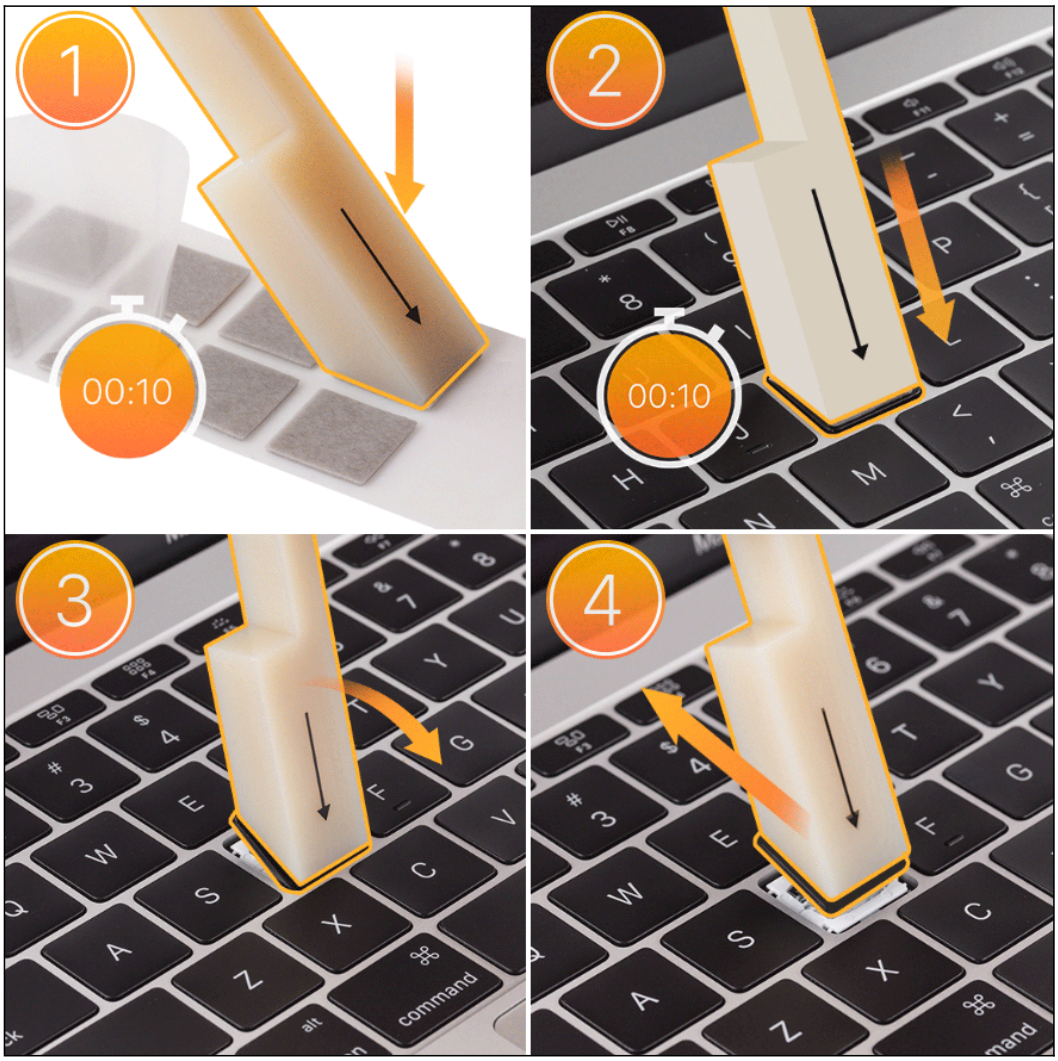
With the introduction of the keycap lever tool, keycaps for MacBook Pro (2016 and 2017) and MacBook (Retina, 12-inch, 2017) computers are now easier and faster to replace. Individual keycaps should be replaced instead of the entire top case. This procedure can be done in under three minutes.

This procedure is the quickest and most cost-effective way to fix the following butterfly mechanism issues:

- Sticking keys (stuck in up or down position)
- Key press feels uneven or stiff
- Keycap not responding, is spongy, or is not going all the way down
- The key makes abnormal noise and/or is a metallic click sound
    - **Note:** For MacBook Pro (2016), first install the keycap shim to the new keycap for this issue. Refer to article TP1550: Keycap Shim Installation.

The procedure involves four basic steps:

1. Applying the adhesive to the tool.
2. Pressing the tool on the keycap for 10 seconds.
3. Pulling the keycap in the correct direction to release snaps.
4. Pushing it in the opposite direction to release hooks.



For video instruction, refer to SV347: Portables Keycap Lever Video.

For part numbers, go to the Keycap Kit Part Numbers section below.

For a guide to placing the lever tool, see the Keycap Lever Placement Map below.

For detailed information on the procedure, go to the Procedure for Removing and Replacing Keycaps section below.

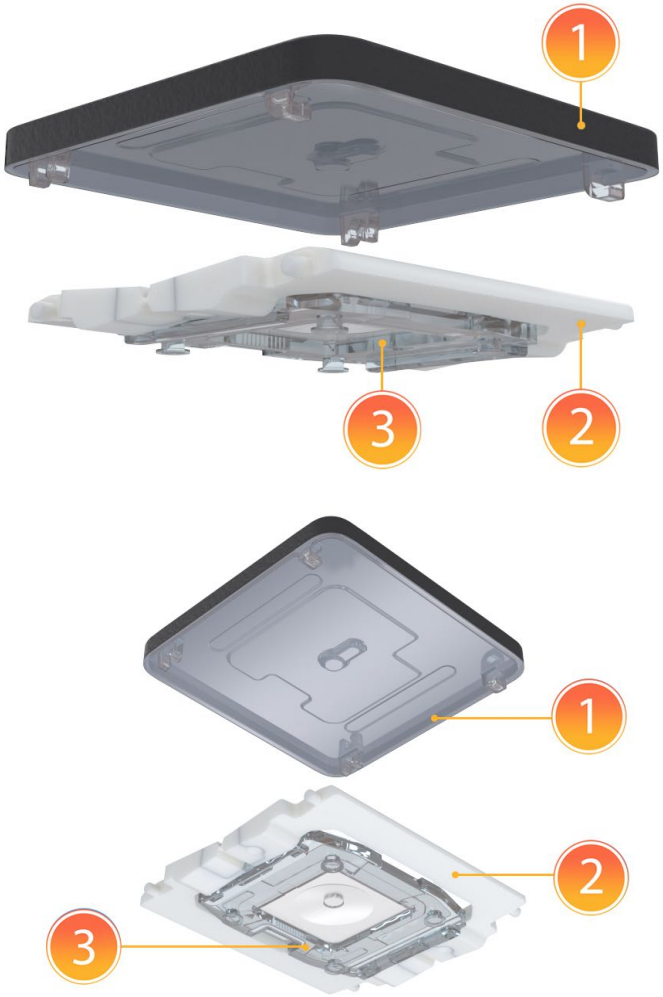
First Steps

- Before replacing the keycap on an unresponsive keyboard, be sure to clean the keyboard thoroughly with compressed air. Then remove the keycap, spray the well with compressed air, and check for liquid damage.
- Before attempting this procedure for the first time, practice on a KBB top case and keyboard with butterfly mechanism.
- Always use a new keycap. Do not attempt to reinstall the keycap that was removed.
- For instructions on removing and replacing the **Space bar**, refer to article OP1469: Butterfly Mechanism Keycap Replacement.
- For instruction on installing a keycap shim to MacBook Pro (2016) keycaps that exhibit a loud clicking sound after the system has warmed up, refer to article TP1550: Keycap Shim Installation.
- For Arabic keyboards, the return key may show uneven backlighting from top to bottom. This is expected behavior. Do not repair or replace for this issue.
- When replacing an option key, make sure the old option key and the new option key have the same glyphs. If they do not, replace both keys.

1. Keycap Anatomy

Keycap mechanisms consist of three parts. Only number 1 is replaceable:

1. Keycap, the surface key that a user sees on the keyboard
2. Butterfly, the hinged piece under the keycap
3. Switch housing, the piece that secures the butterfly to the top case



Important: Although keycaps can be replaced, the butterfly and switch housing cannot. A damaged switch housing or butterfly requires replacement of the entire top case.

If a keycap needs replacement due to accidental damage, such as a liquid spill, refer to article OP14: Determining and quoting accidental damage for Mac portables.

2. Keycap Kit Part Numbers

Important: The keycap kits vary by the computer color and the keyboard language.

To help determine keyboard localization or keycap placement, refer to article HT201794: How to identify keyboard localizations.

Notes:

- Keycap kits are available for UK English (ISO), U.S. English (ANSI), Chinese (ANSI) and Japanese (JIS) version keyboards.
- The **Super ISO** is a European special character kit that includes specific keycap characters for:
  - German (D)
  - French (F)
  - Danish (DK)
  - Italian (T)
  - Spanish (E)
  - Swedish (S)
- **Common Kits** include:
  - ANSI - space bar, left and right shift, caps lock, delete, tab, return, escape
  - JIS - space bar, return, left and right shift, #1, power
  - ISO - space bar, right shift, caps lock, delete, tab, return, escape

MacBook Pro (13-inch, 2016, 2 Thunderbolt 3 Ports)

Part Number	Label Number	Language	Computer Color
923-01088	605-01344	ANSI English	Space Gray
923-01089	605-01345	ANSI English	Silver
923-01661	605-02130	ANSI English Common Kit	Space Gray
923-01660	605-02129	ANSI English Common Kit	Silver
CH923-01088	CH605-01344	ANSI English, China	Space Gray
CH923-01089	CH605-01345	ANSI English, China	Silver
B923-01088	B605-01344	ISO English	Space Gray
B923-01089	B605-01345	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO English	Space Gray
ZM923-01089	ZM605-01345	Super ISO English	Silver
ZM923-01661	ZM605-02130	ISO English Common Kit	Space Gray
ZM923-01660	ZM605-02129	ISO English Common Kit	Silver
J923-01088	J605-01344	Japanese	Space Gray
J923-01089	J605-01345	Japanese	Silver
J923-01661	J605-02130	Japanese Common Kit	Space Gray
J923-01660	J605-02129	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2016, 4 Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016)

Part Number	Label Number	Language	Computer Color
923-01454	605-01811	ANSI English	Space Gray
923-01455	605-01812	ANSI English	Silver
923-01663	605-02132	ANSI English Common Kit	Space Gray
923-01662	605-02131	ANSI English Common Kit	Silver
CH923-01454	CH605-01811	ANSI English, China	Space Gray
CH923-01455	CH605-01812	ANSI English, China	Silver
B923-01454	B605-01811	ISO English	Space Gray
B923-01455	B605-01812	ISO English	Silver
ZM923-01088	ZM605-01344	Super ISO, English	Space Gray
ZM923-01089	ZM605-01345	Super ISO, English	Silver
ZM923-01663	ZM605-02132	ISO English Common Kit	Space Gray
ZM923-01662	ZM605-02131	ISO English Common Kit	Silver
J923-01454	J605-01811	Japanese	Space Gray
J923-01455	J605-01812	Japanese	Silver
J923-01663	J605-02132	Japanese Common Kit	Space Gray
J923-01662	J605-02131	Japanese Common Kit	Silver

MacBook Pro (13-inch, 2017) and MacBook Pro (15-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01849	605-03030	ANSI English	Space Gray
923-01850	605-03031	ANSI English	Silver
923-01857	605-03034	ANSI English Common Kit	Space Gray
923-01858	605-03035	ANSI English Common Kit	Silver
CH923-01849	CH605-03030	ANSI English, China	Space Gray
CH923-01850	CH605-03031	ANSI English, China	Silver
B923-01849	B605-03030	ISO English	Space Gray
B923-01850	B605-03031	ISO English	Silver
ZM923-01857	ZM605-03034	ISO English Common Kit	Space Gray
ZM923-01858	ZM605-03035	ISO English Common Kit	Silver
J923-01849	J605-03030	Japanese	Space Gray
J923-01850	J605-03031	Japanese	Silver
J923-01857	J605-03034	Japanese Common Kit	Space Gray
J923-01858	J605-03035	Japanese Common Kit	Silver

MacBook (Retina, 12-inch, 2017)

Part Number	Label Number	Language	Computer Color
923-01730	605-02311	ANSI English	Space Gray
923-01731	605-02312	ANSI English	Silver, Gold, Rose Gold
923-01732	605-02313	ANSI English Common Kit	Space Gray
923-01733	605-02314	ANSI English Common Kit	Silver, Gold, Rose Gold
CH923-01730	CH605-02311	ANSI English, China	Space Gray
CH923-01731	CH605-02312	ANSI English, China	Silver, Gold, Rose Gold
B923-01730	B605-02311	ISO English	Space Gray
B923-01731	B605-02312	ISO English	Silver, Gold, Rose Gold
ZM923-01730	ZM605-02311	Super ISO, English	Space Gray
ZM923-01731	ZM605-02312	Super ISO, English	Silver, Gold, Rose Gold
ZM923-01732	ZM605-02313	ISO English Common Kit	Space Gray
ZM923-01733	ZM605-02314	ISO English Common Kit	Silver, Gold, Rose Gold
J923-01730	J605-02311	Japanese	Space Gray
J923-01731	J605-02312	Japanese	Silver, Gold, Rose Gold
J923-01732	J605-02313	Japanese Common Kit	Space Gray
J923-01733	J605-02314	Japanese Common Kit	Silver, Gold, Rose Gold

3. Keycap Lever Placement Map

The following illustrations show where to place the keycap lever when removing keycaps.

Release the edge of the keycap at the snaps before releasing the edge with the hooks. For detailed instructions, go to the Procedure section below.

 Yellow: The hooks are on the bottom and the snaps are on the top.

 Blue: The hooks are on the right and the snaps are on the left.

 Orange: There are four snaps on top and four hooks on the bottom.

 Purple: The hooks are on the left and the snaps are on the right.

 Green: There are three hooks on the bottom and three snaps on the top.

 Light Orange: There are three hooks on the right and three snaps on the left.

 Pink (Japan only): The hooks are on the top and the snaps are on the bottom.

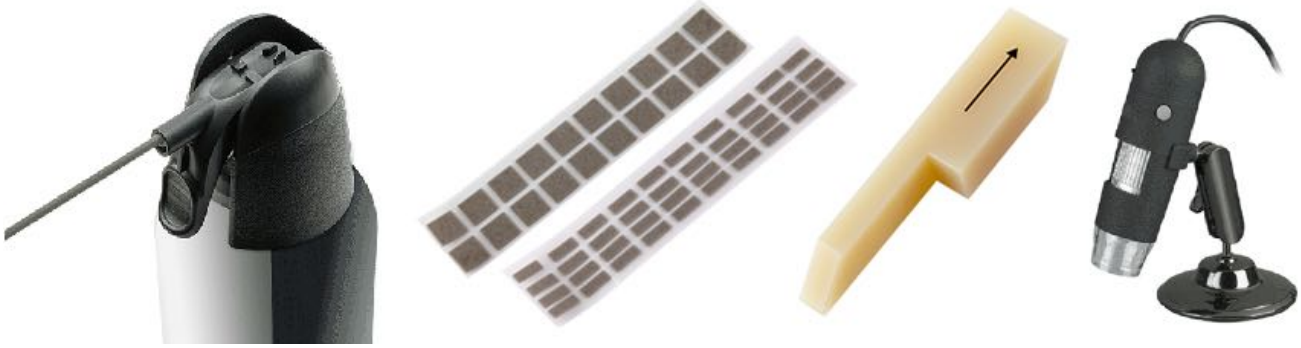
Click on the image below to enlarge it.

4. Procedure for Removing and Replacing Keycaps

Caution:

- Shut down the computer before replacing a keycap.
- Press the keycap lever very gently on the keycap when initializing the VHB. The top case should not bend when pressing the keycap lever tool onto the keycap. Too much pressure can damage the butterfly resulting in a full top case replacement.
- If the butterfly is damaged, a full top case replacement is required.
- Inspect the switch housing with a USB microscope. If the pockets are damaged, a full top case replacement will be required. Refer to step 9 of Section 4A.

Tools:



- Compressed air
- Pre-cut VHB adhesive strips (923-01801, 1x1; 923-01800, 1x.5)

- Keycap lever (923-01803) **Note:** This tool is double-sided. The large side is for yellow, pink, and green keys; the smaller side is for blue, light orange, and purple keys. This tool is not to be used for the space bar (orange keys).
- USB Microscope
- Keycap tool kit (076-00337) includes: Keycap slider tool, keycap lever, Kapton tape, and pre-cut VHB adhesive strips

Note: Before attempting this procedure for the first time, practice on a KBB top case and keyboard with butterfly mechanism.

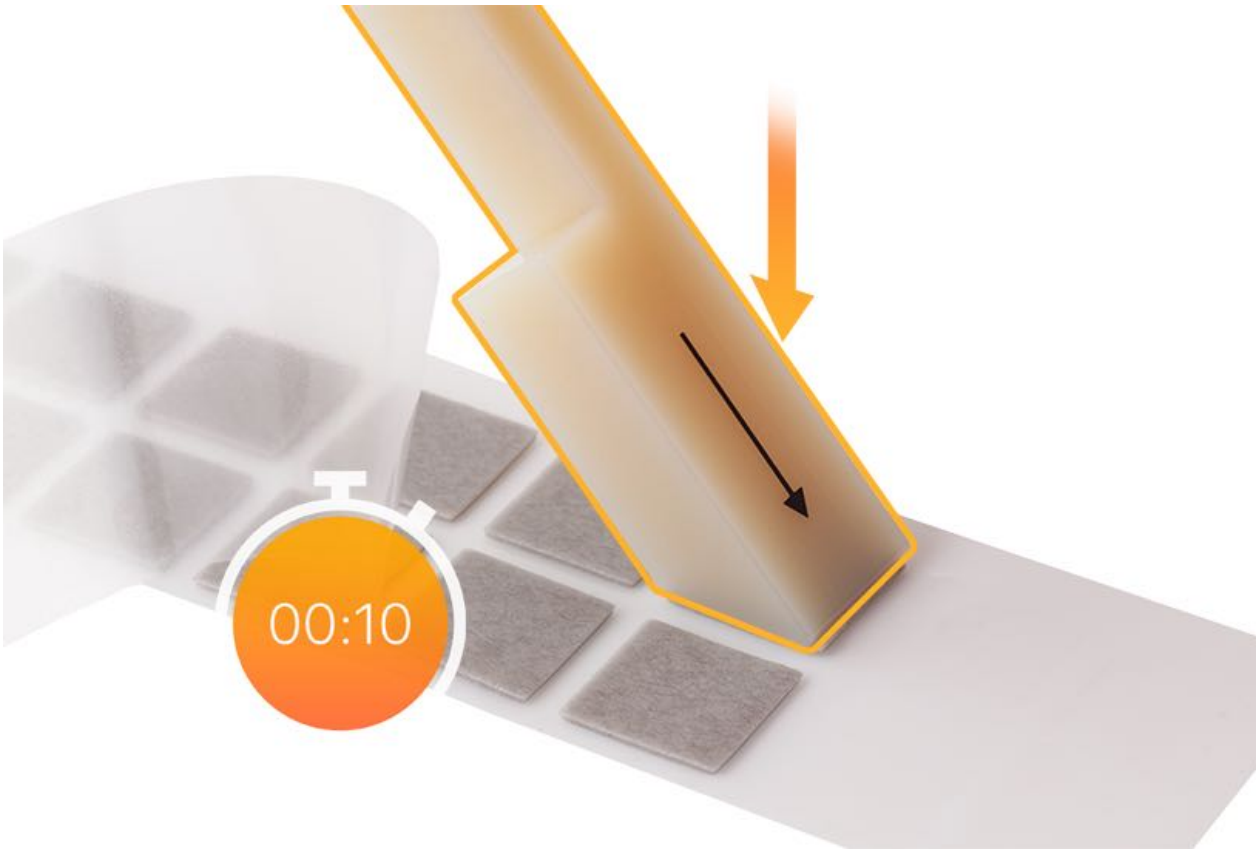
Follow these steps to remove and replace a keycap.

There are four types of keys on the keyboard. Each type requires a different procedure.

- For instructions on removing and replacing the **Space bar**, refer to article OP1469: Butterfly Mechanism Keycap Replacement.

A. Removing and Replacing Yellow, Green, and Pink Keys

1. Peel back the frosted paper liner from one side of the adhesive. Press the large end of the keycap lever tool onto the 1x1 adhesive and hold for 10 seconds.



2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the key, aligning the arrow on the tool with the hooks on the keycap. See the keycap map for location of hooks.

Note:

- On the larger keys such as caps lock, return, shift, tab, delete, command, place the tool in the middle of the key.
- If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.

5. Slowly pull the lever away from the display to unsnap the keycap. Stop when you hear a click.

6. Then push the lever tool up towards the display to unhook the keycap hooks and remove the keycap.

7. Remove the keycap and the adhesive from the keycap lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

8. Visually inspect the keycap well for debris or foreign objects. If debris is found, use compressed air to clean the keycap well. **Note:** If the debris is visible and compressed air does not dislodge it, use a black stick to gently dislodge the debris.

9. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of

place.

10. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.

11. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.

12. Always replace the keycap with a new one. Do not reuse keycaps. Insert the bottom of the keycap into the well at a 15-degree angle and gently push to engage the hooks.

13. Gently push down on the top of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.

14. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

15. When replacing the option key, check to make sure both keys have the same glyphs. If the new option key is different from the old one, replace both keys.

B. Removing and Replacing the Up Arrow Keys (Purple), ISO and JIS Return Keys (Light Orange), and the Function and Down Arrow Keys (Blue)

Steps for Removing the Up Arrow Key

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.

2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the up arrow key, aligning the arrow with the hooks on the left side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.

5. Pull the lever to the left to unsnap the keycap. Stop when you hear a click.

6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.

7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Steps for Removing the Down Arrow, JIS and ISO Return, and Function Keys

1. Peel back the frosted paper liner from one side of the adhesive. Press the small end of

the keycap lever tool onto the 1x.5 adhesive and hold for 10 seconds.

2. Lift the tool, with the adhesive attached, from the clear liner.

3. Lightly press the tool with the adhesive side down, onto the down arrow key or function key, aligning the arrow with the hooks on the right side.

Note: If the tool is accidentally placed onto the wrong keycap continue with the removal process and replace with a new keycap. This is necessary due to the strength of the adhesive.

4. Hold for about 10 seconds to activate the adhesive.

5. Slowly pull the lever to the right to unsnap the keycap. Stop when you hear a click.

6. Then push the lever slightly forward to unhook the hooks and lift up to remove the keycap.

7. Remove the keycap and the adhesive from the lever and discard both. **Note:** The adhesive is one-time use only and needs to be replaced for every keycap removal.

Replacing the Arrow Keys, JIS and ANSI Return Keys, and Function Keys

1. Visually inspect the butterfly. Be sure the pins are properly seated and have not popped out of place.

2. Using the flat end of a black stick, gently tap the edge of the butterfly on the side of the hinge (circled) and verify that the butterfly moves up and down.

3. If the pins are damaged or not in place or the butterfly does not move up and down, a whole top case replacement is necessary.

4. Always replace the keycap with a new one. Do not reuse keycaps.

- For the up arrow, insert the right side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.
- For the down arrow and function keys, insert the left side of the keycap into the well at a 15-degree angle and gently push to engage the hooks.

5. Gently push down on the left side of the keycap to engage the snaps. If the keycap is not lined up properly, the snaps will not engage. If this happens, start again.

6. Check the key from all angles to make sure it is uniformly flat. Tap the key repeatedly to verify that it springs back each time. Compare the response of the new keycap with the keycaps around it.

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Liquid Contact Indicators

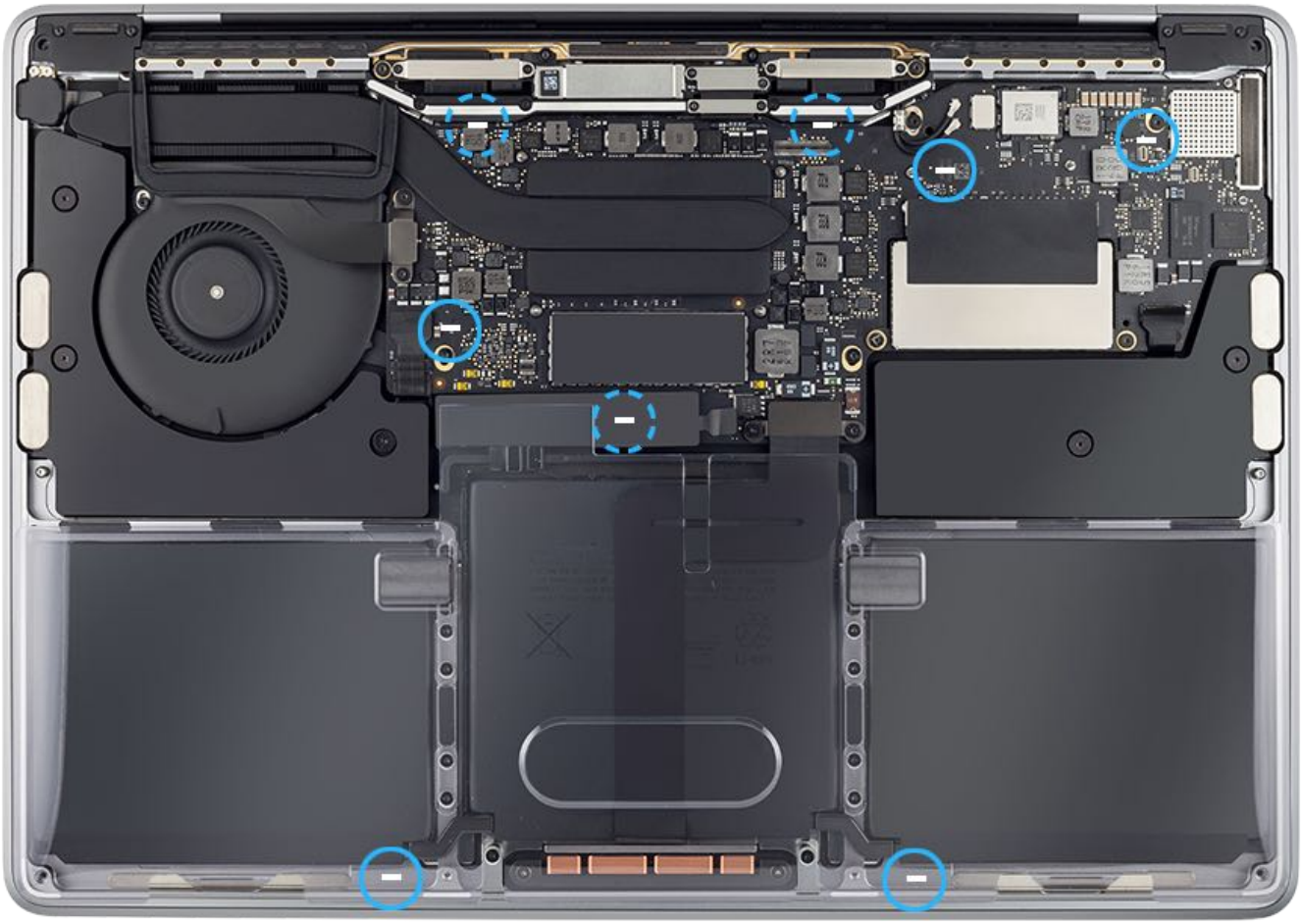
Liquid Contact Indicators for MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)

The top case includes spill sensors called liquid contact indicators (LCIs) to help discover accidental damage to the computer. The sensors are visible only when the bottom case and most of the modules have been removed. Normally represented by small white lines, the LCIs turn red when they have come in contact with liquid, such as an accidental spill.

For more information, refer to article HT204769: Mac computers: About liquid contact indicators (LCIs) and warranty coverage.

The following image shows the general location of the LCIs in this computer.

Legend:
A dotted blue line indicates the indicator is underneath the marked area.



General Troubleshooting

Update Software and Firmware

Important: Before you begin troubleshooting, ensure the correct version of macOS is installed, and check for and apply the latest software and firmware updates. Computers sometimes exhibit symptoms that indicate the wrong version of macOS system software is installed. Check article HT204319: macOS versions and builds included with Mac computers to make sure system build is correct for this computer model.

Firmware is the name given to software that is written into memory circuits such as flash memory, that will hold the software code indefinitely, even when power is removed from the hardware. Firmware on Intel Mac computers is designed to be updated if necessary by running the macOS Software Update check (available in the Apple (ï£¿menu) while the computer is connected to the Internet.

For more information about firmware updates, refer to article HT201518: About EFI and SMC firmware updates for Intel-based Mac computers.

Troubleshooting Techniques

For more information, go to ATLAS and enter “troubleshooting” in the search field.

Hardware vs. Software

To isolate a hardware issue from a software issue, refer to article HT203161: Isolating issues in macOS.

To troubleshoot a software issue, refer to the following articles:

- HT201516: How to troubleshoot a software issue
- HT201861: About incompatible software on your Mac
- HT204323: If a flashing question mark appears when you start your Mac
- HT204904: How to reinstall macOS
- HT202574: Mac mini (Late 2012 and later), iMac (Late 2012 and later): About Fusion Drive

Quick Check Procedures

Resetting the System Management Controller (SMC)

The System Management Controller (SMC) is a chip on the logic board that controls all power functions. If the computer is experiencing any power issue, such as not starting up, not displaying video, sleep issues, or fan noise issues, resetting SMC may resolve it.

For more information and instructions to reset the SMC on different computer models, refer to article HT201295: Reset the System Management Controller (SMC) on your Mac.

Note for iMacs: If the power button is pressed while inserting the power cord, the iMac will enter a mode in which the fans run at full speed. For more information, refer to article HT204463: iMac: Fans run at full speed after computer turns on.

Resetting Non-Volatile RAM (NVRAM)

NVRAM stores certain system and device settings in a location that macOS can access quickly. Exactly which settings are stored in the computer's NVRAM varies depending on the type of computer as well as the types of devices and drives connected. To reset NVRAM:

1. Shut down the computer.
2. Locate the following keys on the keyboard: Command, Option (Alt), P, and R. You will need to hold these keys down simultaneously in Step 4.
3. Press power button.
4. Immediately press and hold Command-Option-P-R keys.
   Important: You must press this key combination before the gray screen appears.
5. Hold down keys until computer restarts, and you hear startup chime a second time.
   Note: For MacBook Pro (Late 2016 and 2017) and MacBook (Retina, 12-inch, 2017), hold down keys for at least 20 seconds. There is no startup chime.
6. Release keys.

Note: After resetting NVRAM, you might need to reconfigure settings for speaker volume, screen resolution, startup disk selection, and time zone information.

For more information, refer to article HT204063: How to Reset NVRAM on your Mac.

Starting Up in Safe Mode

Safe Mode (sometimes called Safe Boot) is a way to start up a Mac so that it performs certain checks and prevents some software from automatically loading or opening. These changes can help resolve or isolate certain issues on the startup disk.

Follow these steps to start up into Safe Mode:

1. Be sure the computer is shut down.
2. Press the power button.
3. Press and hold the Shift key.
   Note: The Shift key should be pressed as soon as possible after the power button is pressed.
4. Release the Shift key when you see the Apple logo appear on the screen. After the Apple logo appears, it may take longer than usual to reach the login screen. This is because the computer is performing a directory check as part of Safe Mode.
5. To leave Safe Mode, restart the computer without pressing any keys during startup.

For more information, refer to article HT201262: Use Safe Mode to isolate issues with your Mac.

Recovering a Lost Firmware Password

Only Apple Retail Stores or Apple Authorized Service Providers can unlock the following Mac models when protected by a firmware password:

- iMac (Mid 2011 and later)
- MacBook (Retina, 12-inch, Early 2015 and later)
- MacBook Air (Late 2010 and later)
- MacBook Pro (Early 2011 and later)
- Mac mini (Mid 2011 and later)
- Mac Pro (Late 2013)

Refer to the technician instructions in article HT203409: If you lost or forgot your firmware password.

Sleep Status Tips

Sleep Status Tips for MacBook (Retina, 12-inch, Early 2015 and later) and MacBook Pro (2016 and later)

These computer models do not have a sleep LED. To troubleshoot without one:

- Press and hold the Caps Lock key to wake the computer from sleep. The Caps Lock LED is a good indication of power.
- Check the haptic response of the trackpad. The trackpad will not have any haptic response when there is no power to the system.
- Open the display and press an alphanumeric key to wake the computer from sleep.
- A computer that has been asleep for an extended period can consume the remaining charge of the battery. Restore power to the computer with a known-good power adapter.
  The computer will start up from a hibernation file and start up from where it left off.
- Use an Apple USB-C to USB Adapter, Apple USB-C Digital AV Multiport Adapter, or an Apple USB-C VGA Multiport Adapter to connect a USB device that has a power-on or activity LED. As power is restored to the USB and the system wakes from sleep, the LED lights up.
  Note: An Apple USB-C to USB adapter may be used if power does not need to be supplied to the computer.
- Resetting the SMC instantly shuts down the computer, with some side effects:
  - If the computer is in sleep mode, it will reboot from a hibernation file.
  - If the computer is running OS X or macOS during the SMC reset, data from open applications can be lost.
  - If the computer is already shut down, there will be no side effects.

Diagnostic Software

Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for iOS devices and Mac computers released in June 2014 and later, except for MacBook Pro (Retina, Mid 2014). With AST 2, technicians initiate diagnostics wirelessly on a user's device using a Diagnostic Console (a web application on a Mac or iPad). Technicians are also able to view diagnostic results on the Diagnostic Console.

For more information, refer to:

- OP476: Latest Apple Service Toolkit download links and documentation
- TP1105: AST 2 for Mac Reference Guide - Table of Contents
- TP1118: AST 2 for Mac Reference Guide - Table of Contents (Retail)

Apple Diagnostics

Apple Diagnostics is a customer-facing software tool that is built-in to all Mac computers released in June 2013 and later.

For more information, refer to:

- HT202731: How to use Apple Diagnostics on your Mac
- HT203747: Apple Diagnostics: Reference codes

Thermal and Electrical Sensors

Reference the tables below for MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports) sensor information.

Thermal Sensor Table

SMC Name	Location	General Description (Degrees C)	Repair Suggestion
Ta0P	Logic board bottom side, rear edge, near air vent	Ambient air temperature	Excessive air intake temperature or logic board sensor is damaged or disconnected from SMC. Verify fan is operational for proper cooling.
TaLC	Logic board top side, left, near left USB-C ports	Airflow temperature	Excessive I/O temperature or logic board sensor is damaged or disconnected from SMC. Verify USB-C I/O connections and fan operation.
TB0T	Battery	Battery TS_MAX temperature	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB1T	On BMU	Battery TS1 temperature	Excessive battery temperature, open/damaged BMU or logic board contacts.
TB2T	Near battery cell	Battery TS2 temperature	Excessive battery temperature, open/damaged BMU or logic board contacts.
TBXT	Battery	Battery temperature (Same as TB0T)	Excessive battery temperature, open/damaged BMU or logic board contacts.
TC0P	Logic board bottom side, under CPU	CPU proximity temperature	Excessive CPU temperature or logic board sensor near CPU is damaged or disconnected from SMC.
TC1C	Logic board bottom side, CPU	CPU die - Digital Core 0 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TC2C	Logic board bottom side, CPU	CPU die - Digital Core 1 temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCGC	Logic board bottom side, CPU	CPU Gfx Core temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCMX	Logic board bottom side, CPU	Max PECI reported temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCSA	Logic board bottom side, CPU	CPU System Agent Core temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TCXC	Logic board bottom side, CPU	CPU Core PECI temperature	Excessive CPU temperature or internal CPU sensor is damaged or disconnected from SMC.
TH0A	Flash storage module, bottom side, center	S3x Proximity temperature	Excessive flash storage temperature or sensor near flash storage is damaged or disconnected from SMC.
TH0B	Flash storage module, bottom side, center	NAND#1 Proximity temperature	Excessive flash storage temperature or sensor near flash storage is damaged or disconnected from SMC.
TH0C	Flash storage module, bottom side, center	NAND#2 Proximity temperature	Excessive flash storage temperature or sensor near flash storage is damaged or disconnected from SMC.
TH0F	Flash storage module, bottom side, center	Drive 0 OOBv3 relative filtered temperature max	Excessive flash storage temperature or sensor near flash storage is damaged or disconnected from SMC.
TH0R	Flash storage module, bottom side, center	Drive 0 OOBv3 relative converted temperature max	Excessive flash storage temperature or sensor near flash storage is damaged or disconnected from SMC.
Th1H	Logic board top side, right rear corner, near heat sink	Fin stack proximity temperature	Excessive heat sink fin stack temperature or fin stack proximity sensor on logic board is damaged. Verify fan is operational for proper cooling.
TI0P	Logic board bottom side, left, near USB-C ports	I/O proximity temperature	Excessive I/O temperature or sensor is damaged or disconnected from SMC. Verify USB-C I/O connections and fan operation.
TM0P	Logic board bottom side, under shield, between memory ICs	Memory proximity temperature	Excessive memory area temperature or logic board sensor near memory is damaged or disconnected from SMC.
TPCD	Logic board bottom side, center, near large PCH IC	PCH Die - Digital temperature	Excessive PCH temperature or logic board sensor near PCH is damaged or disconnected from SMC.
Ts0P	Trackpad	Palm rest temperature	Excessive trackpad / palm rest area temperature or sensor is damaged or disconnected from SMC.
Ts1P	Actuator (trackpad)	Trackpad actuator temperature	Excessive trackpad actuator temperature or sensor is damaged or disconnected from SMC.

Electrical Sensor Table

SMC Name	Location	General Description	Units	Repair Suggestion
IC0R	Logic board	Current: CPU High (CPU GT/GTX/VCCIO/MEM)	Amperes	Out of range CPU current was found or open signal to SMC.
ICAM	Logic board	Current: CPU IA Core (IMON)	Amperes	Out of range CPU current was found or open signal to SMC.
ICGM	Logic board	Current: CPU GT+GTX (IMON)	Amperes	Out of range CPU current was found or open signal to SMC.
ICSM	Logic board	Current: CPU SA	Amperes	Out of range CPU current was found or open signal to SMC.
ID0R	Logic board	Current: USBC/MPM input (AMON)	Amperes	Out of range DC-IN current. Possible defective power adapter, defective USB-C connector or open signal to SMC. Verify the correct power adapter, charge cable, and I/O connections.
IHCC	Logic board	Current: SSD Picollo 3.3V	Amperes	Out of range flash storage current found or open signal to SMC.
IHNC	Logic board	Current: SSD NAND	Amperes	Out of range flash storage current found or open signal to SMC.
IPBR	Logic board	Current: Battery (BMON)	Amperes	Out-of-range battery current was found or open signal to SMC. Verify the battery connection to the logic board.
VCAC	Logic board	Voltage: CPU IA Core	Volts	Out of range voltage from the CPU's integrated voltage regulators. Possible issue with the CPU.
VCGC	Logic board	Voltage: CPU VCCGT/GTX	Volts	Out of range voltage from the CPU's integrated voltage regulators. Possible issue with the CPU.
VD0R	Logic board	Voltage: USBC/MPM input (AMON)	Volts	Out of range DC-IN voltage. Possible defective power adapter, defective USB-C connector or open signal to SMC. Verify the correct power adapter, charge cable, and I/O connections.
VP0R	Logic board	Voltage: P-Bus	Volts	Out of range voltage from battery or charge circuity found on the logic board, or open signal to SMC. Use correct power adapter and verify that the connector pins are clean and make a good electrical connection. Recharge the battery.

Temperature Concerns

The normal operating temperature of this computer is well within national and international safety standards. Nevertheless, users may be concerned about generated heat. To prevent an unnecessary repair, compare a user's computer to a similar running model under similar load, if available at the repair site.

For more information, refer to articles

- HT201640: Mac notebooks: Operating temperature
- HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity
- HT202179: About fans and fan noise in your Mac

LCD Pixel Anomalies

When displaying a single color over the screen area, the LCD panel might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels—red, green, and blue—that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning that subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on the LCD panel. For example, the LCD panel used in the iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means that there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, which results in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest quality LCD panels in its products; however, pixel anomalies can occur in a small percentage of panels.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped somewhere inside the display or on the front surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the outer surface of the display or glass panel can be easily removed using a lint-free cloth.
- For iMacs only, foreign material trapped between the glass panel and display should be removed by an Apple Authorized Service Provider or Apple Retail Store.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

To determine if the display has an acceptable number of pixel anomalies, see the appropriate article:

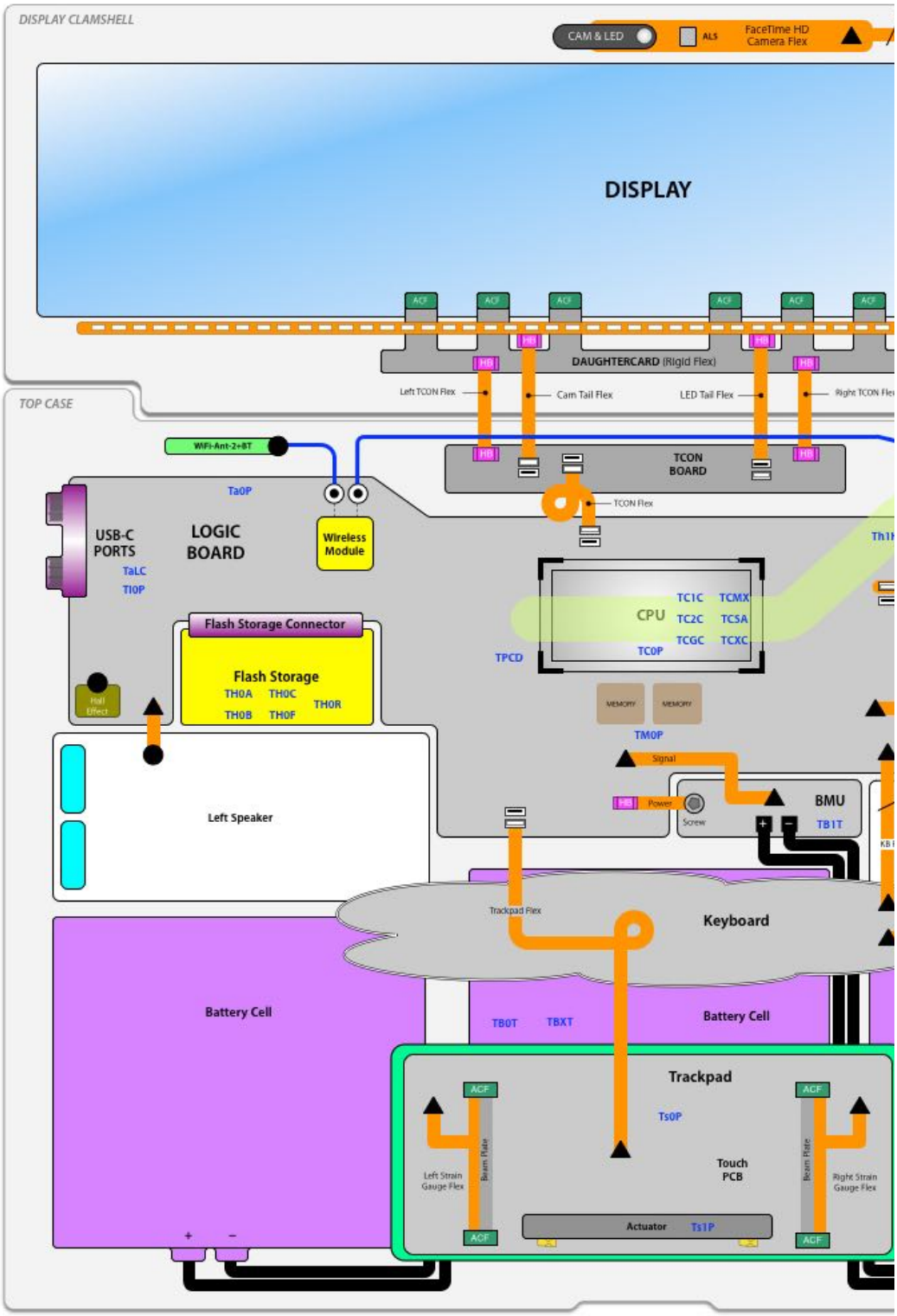
- HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later
- HT201613: About LCD display pixel anomalies for Apple products released before 2010

Interconnect Diagram

Interconnect Diagram for MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)

Refer to this diagram to see how modules are interconnected. Click or tap on the image to see a larger version.

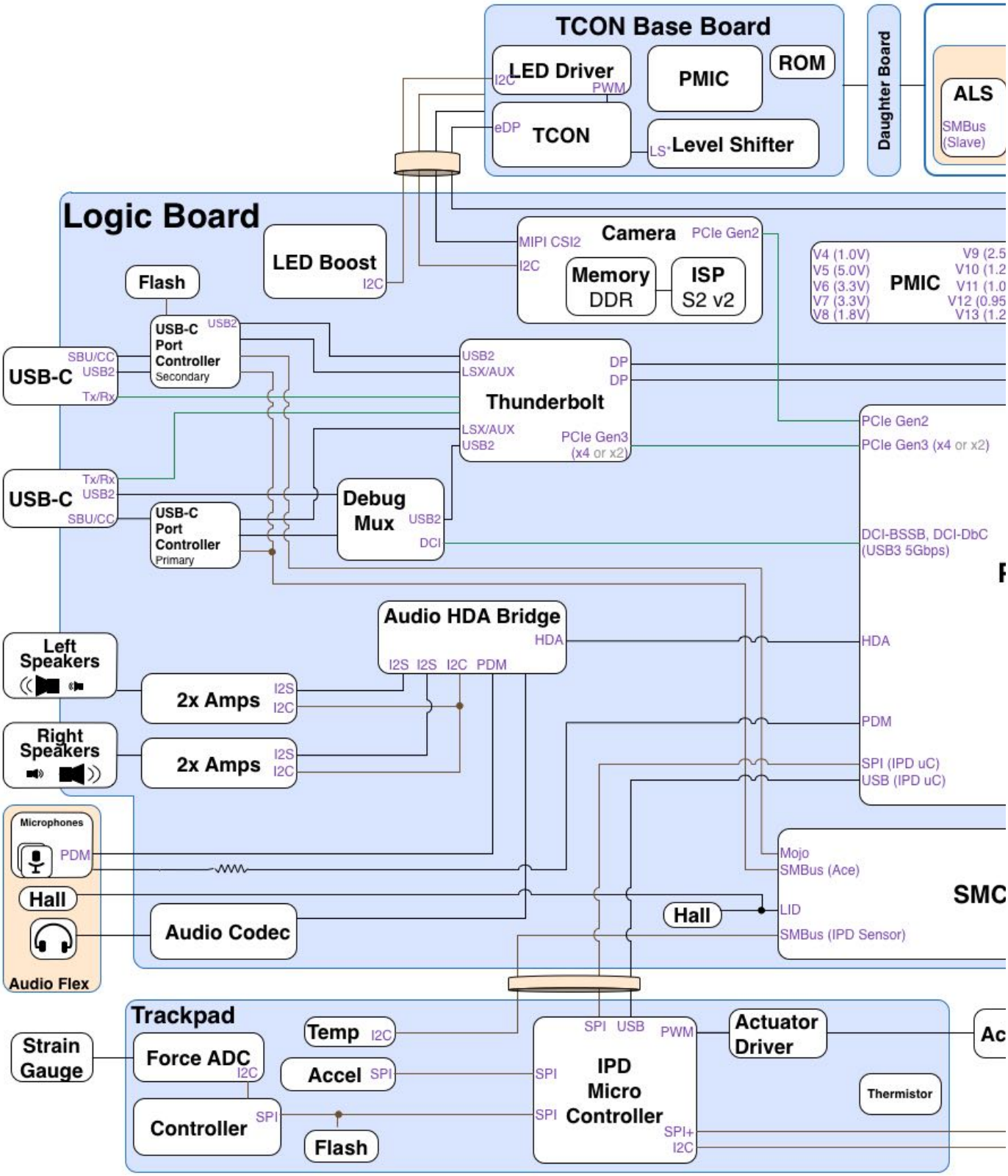
LEGEND	
	Flex
	Coax
	Wire
	ZIF
	LIF
	WTB
	BTB (Rcpt)
	BTB (Plug)
	BTB (Other)
	Rigid Flex
HB	Hot Bar
ACF	Anisotropic Conductive Film
	Direct Solder
	WTB Circular
	Custom Conn
/	# of Lanes/Wires
Ta0P	Temperature sensor



Block Diagram

Block Diagram for MacBook Pro (13-inch, 2016, Two Thunderbolt 3 Ports)

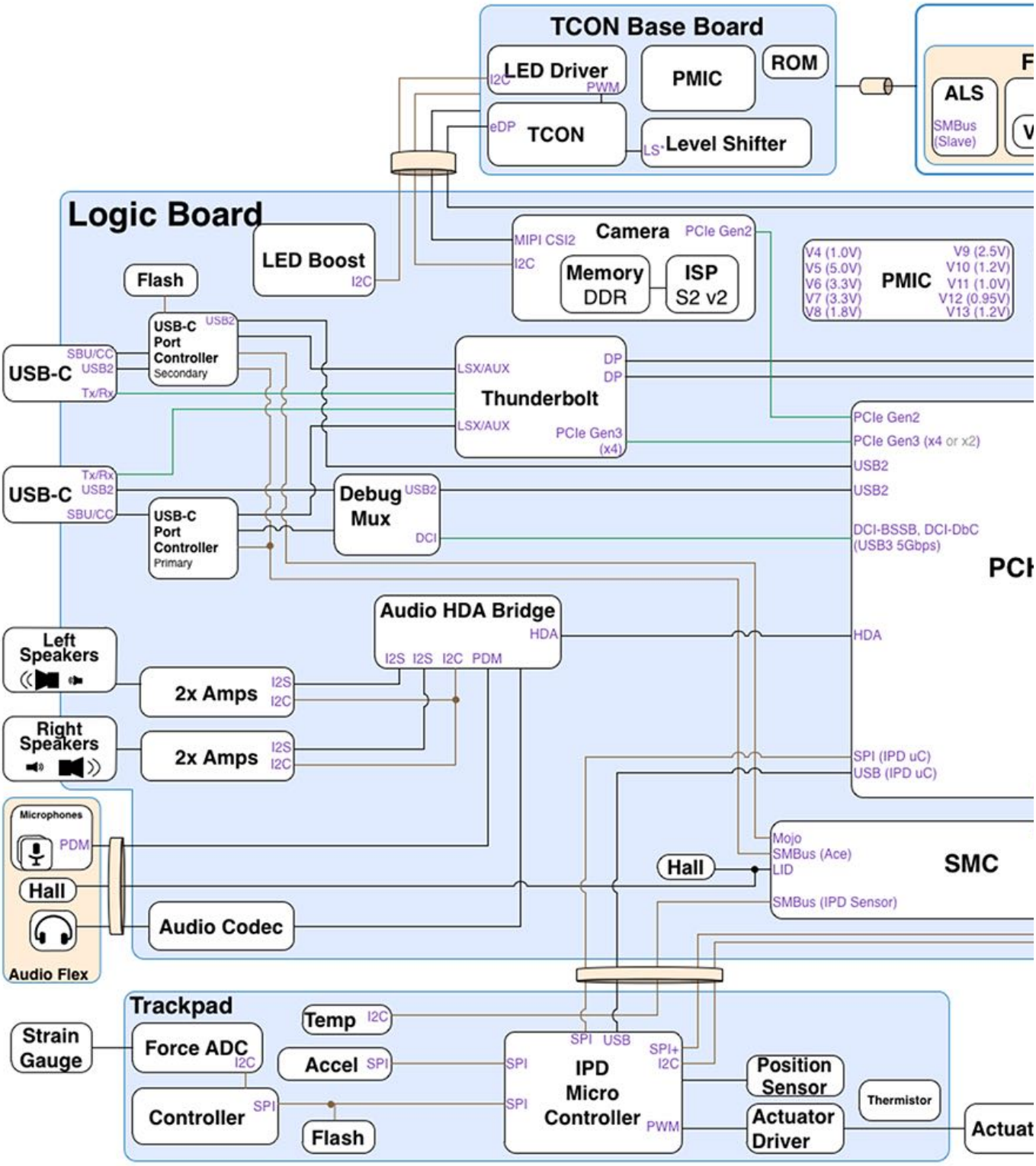
Refer to this diagram to see how modules are interrelated. Click or tap on the image to see a larger version.



Block Diagram

Block Diagram for MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports)

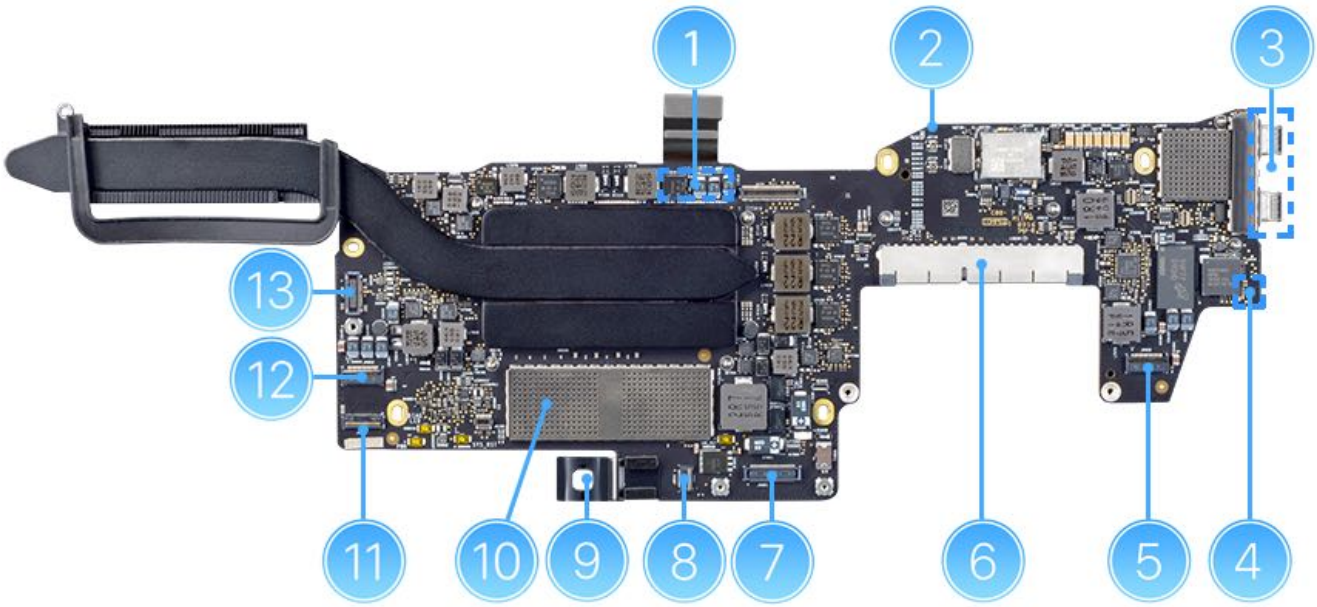
Refer to this diagram to see how modules are interrelated. Click or tap on the image to see a larger version.



Functional Overview

Functional Overview for MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)

Refer to this diagram for symptoms related to logic board connectors.



1 = Embedded DisplayPort (eDP) cable (also carries FaceTime HD camera & Ambient Light Sensor signals)

- No video, blurred, or monochrome video on LCD
- No display backlight
- Display does not dim in low light conditions
- Keyboard backlight cannot be enabled
- Camera does not function

2 = Wi-Fi + Bluetooth antenna connectors

- No/poor Wi-Fi reception
- Drops Wi-Fi connection
- No pairing with Bluetooth devices
- Drops Bluetooth connection

3 = USB-C ports

- No power
- No power LED
- No battery charge
- Power adapter issues
- USB connectivity issues
- USB power issues
- No video to external display
- No audio to external display speakers
- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issue
- Thunderbolt power issues

4 = Left Hall effect sleep sensor

- No sleep when display closed
- No video to internal display, but video to external display is one is connected (sensor stuck)

5 = Left speaker

- No/distorted audio from left speaker

6 = Flash storage card

- Flash Storage device not visible in System Information
- OS boot failure from internal flash storage

7 = Trackpad flex cable

- No Multi-Touch or cursor movement from built-in trackpad
- No click action from built-in trackpad

8 = Battery (BMU signal flex)

- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- Battery removed - extended time before startup and fan running at full speed

9 = Battery (BMU power flex and BMU interconnect screw)

- Not running when on battery only
- Not charging (verify with correct model of power adapter)
- X symbol for battery in menu bar
- Battery removed - extended time before startup and fan running at full speed

10 = Onboard Memory (soldered on logic board)

- Three beep tones on startup
- Freeze or kernel panic
- Horizontal video lines

11 = Keyboard flex cable (also carries keyboard backlight controls and fan power)

- Will not turn on from keyboard
- Non-responsive keys
- No keyboard backlight
- Fan not running
- Intermittent shutdown

12 = Right speaker

- No/distorted audio from right speaker

13 = Audio board flex cable (also carries right Hall effect sleep sensor)

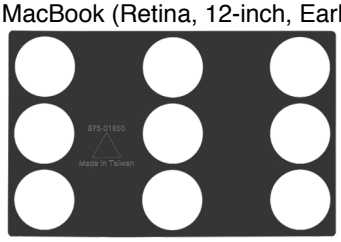
- No internal audio input (with Internal Microphone selected in Sound Input Preferences)
- No external analog audio/digital optical output
- No headset controls or mic input
- No sleep when display closed
- No video to internal display, but video to external display if one is connected (sensor stuck)

Trackpad Calibration Check

For video instruction, refer to article SV279: Force Touch Trackpad Calibration Check Video.

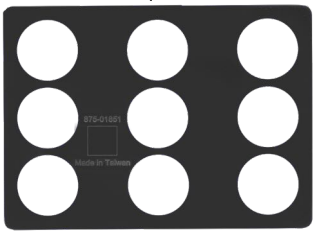
Required tools:

- Weight Placement Rubber Template (923-00555)
  - MacBook (Retina, 12-inch, Early 2015, Early 2016, and 2017)



- Weight Placement Rubber Template (923-01316)
  - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)
  - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)

- Weight Placement Rubber Template (923-00599)
  - MacBook Pro (Retina, 13-inch, Early 2015) and (Retina, 15-inch, Mid 2015)



- Weight Placement Rubber Template (923-01317)
  - MacBook Pro (15-inch, 2016 and 2017)

Note: Weight Placement Rubber Templates come in a pack of three. If the edges start to curl, it is necessary to order a new pack.

- 200g and 800g weights (923-00462)

Steps:

To verify that the trackpad is responding as expected, the technician must run the Trackpad Calibration Check after every repair or whenever the computer has been reassembled.

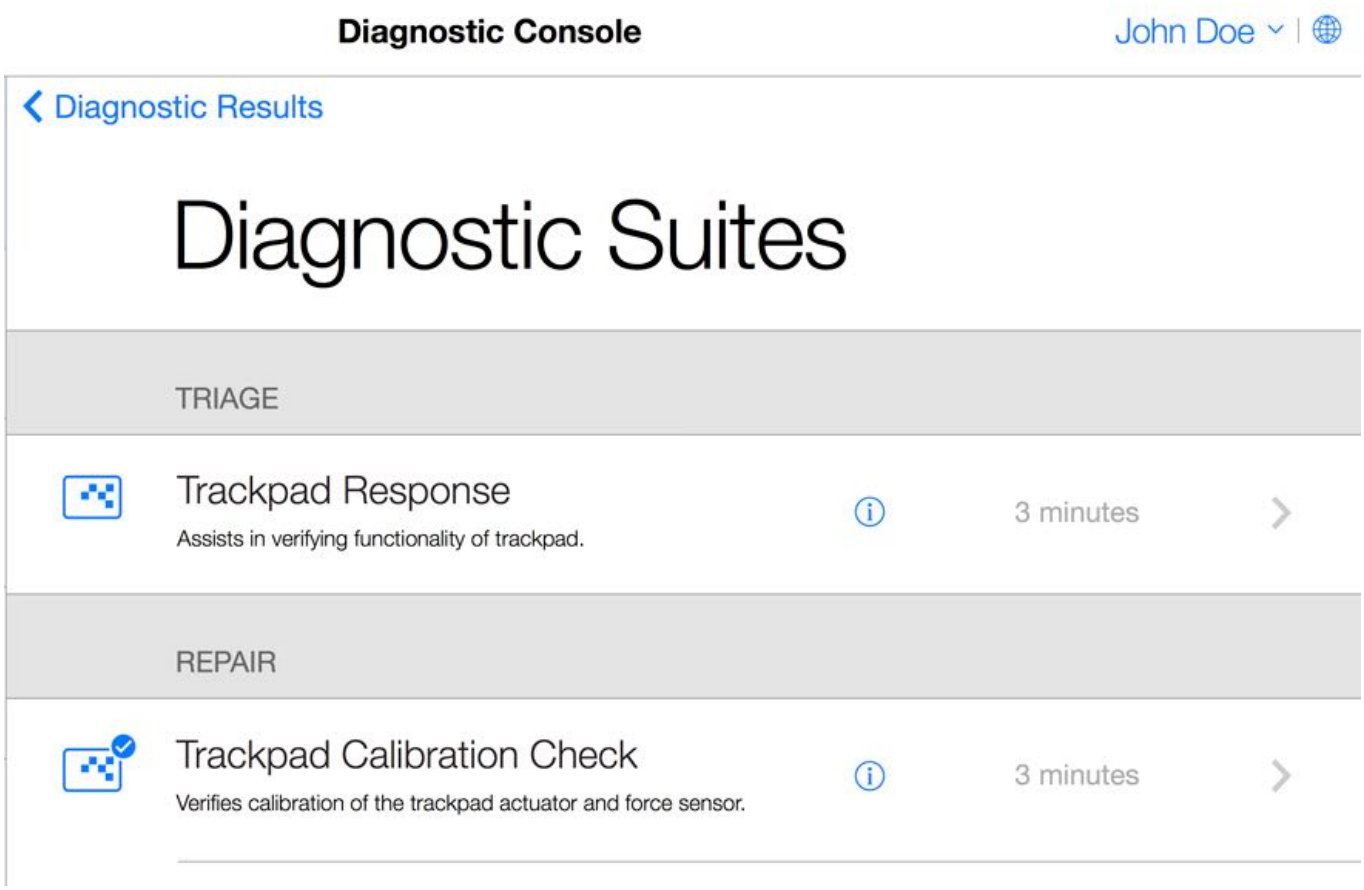
Note: It is recommended to also run the Trackpad Response test after a top case with keyboard has been replaced, or if the user is having issues related to trackpad functionality.

1. Place the Weight Placement Rubber Template on the trackpad before launching the test in AST 2. This establishes the correct baseline for the weights.

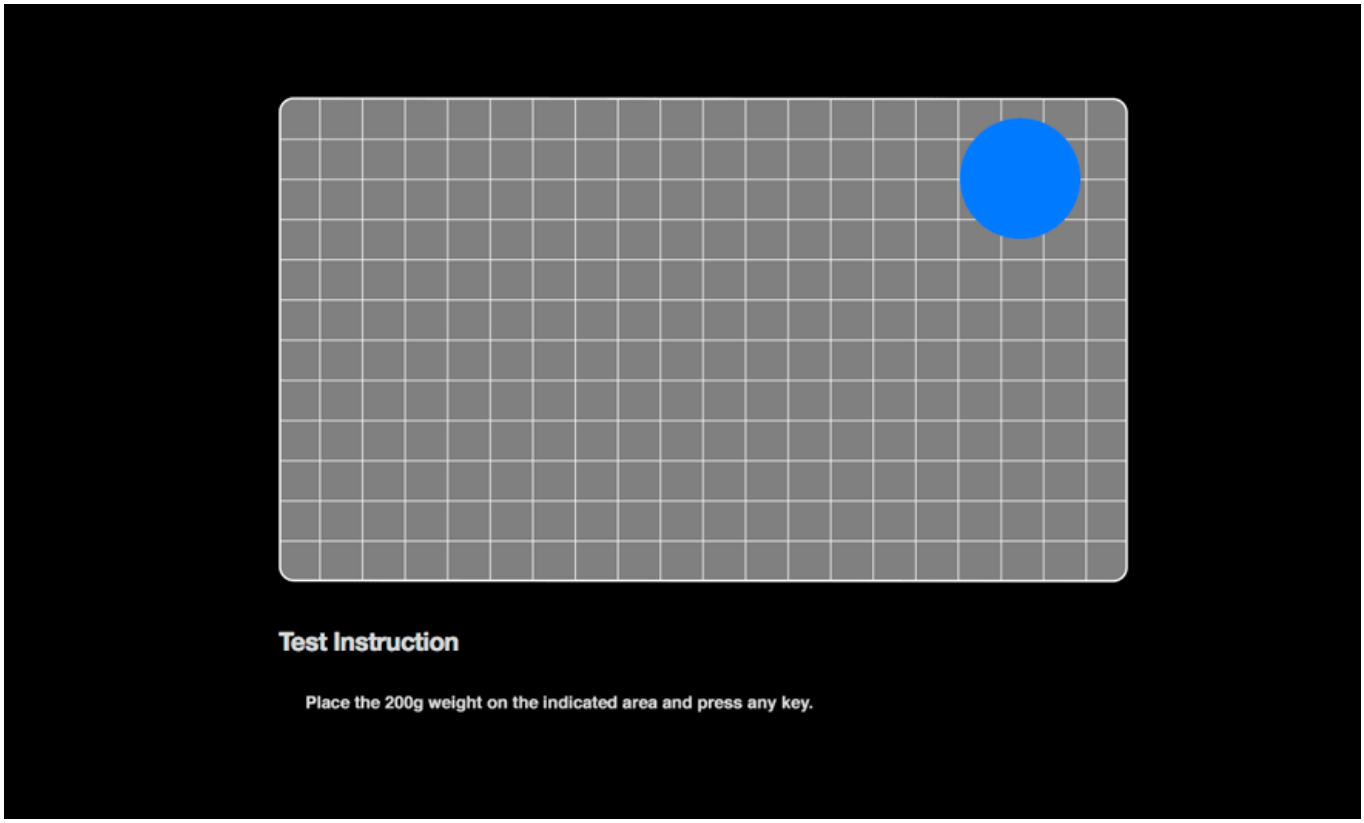
Important: The Weight Placement Rubber Template does not need to be taped to the top case. Tape may cause inaccurate test results.

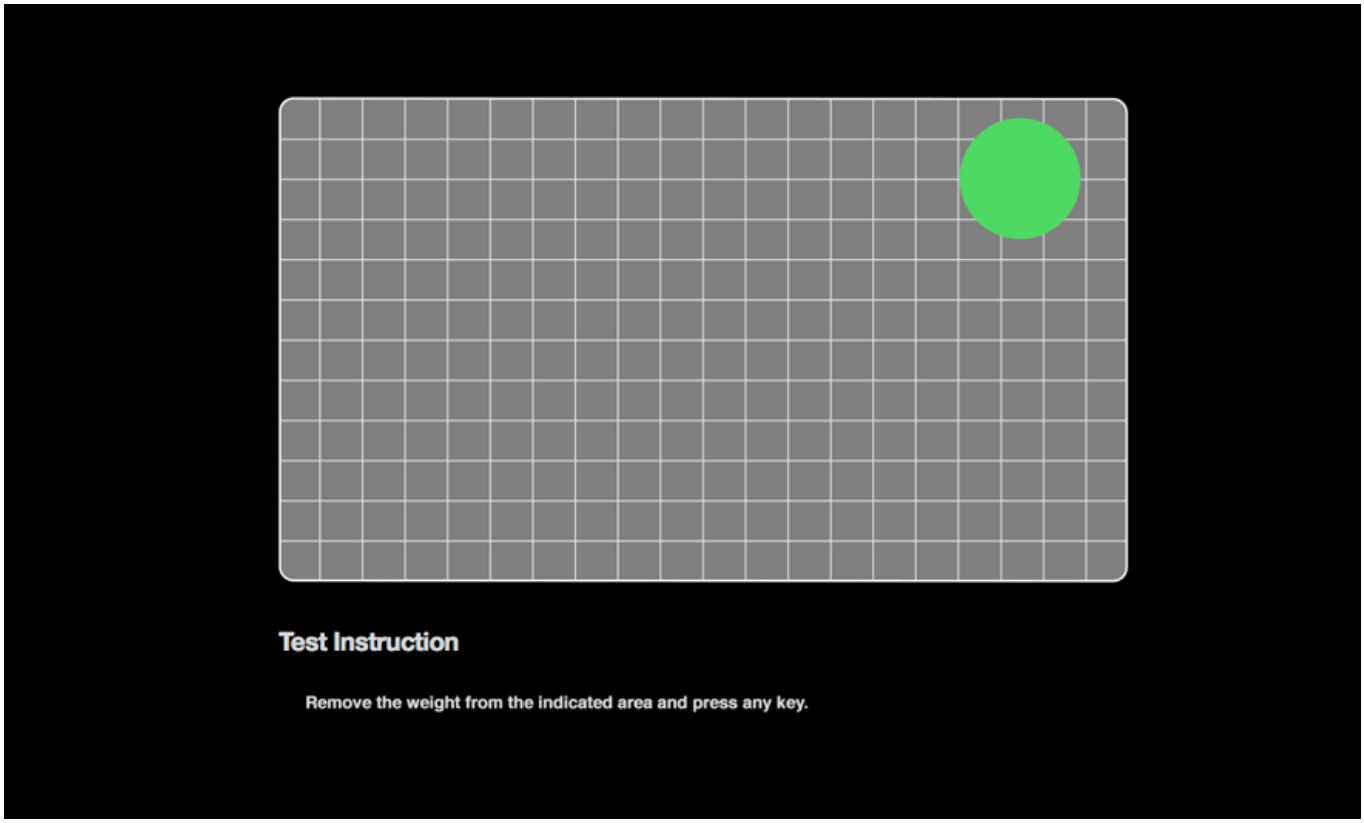
2. Launch AST 2. In Diagnostic Console, select Trackpad Calibration Check from the list of diagnostic suites. For more information on AST 2, refer to article TP1279: AST 2: Supported Products and Tests.

Caution: The Trackpad Calibration Check is very sensitive to external disturbances. The test should be run on a flat surface. Do not run the diagnostic on a bench where other technicians are working. To avoid interfering with the results, be sure to place weights down gently on a separate surface while running the diagnostic. If the computer is bumped or jostled while the diagnostic is running, the technician will have to begin the test again.



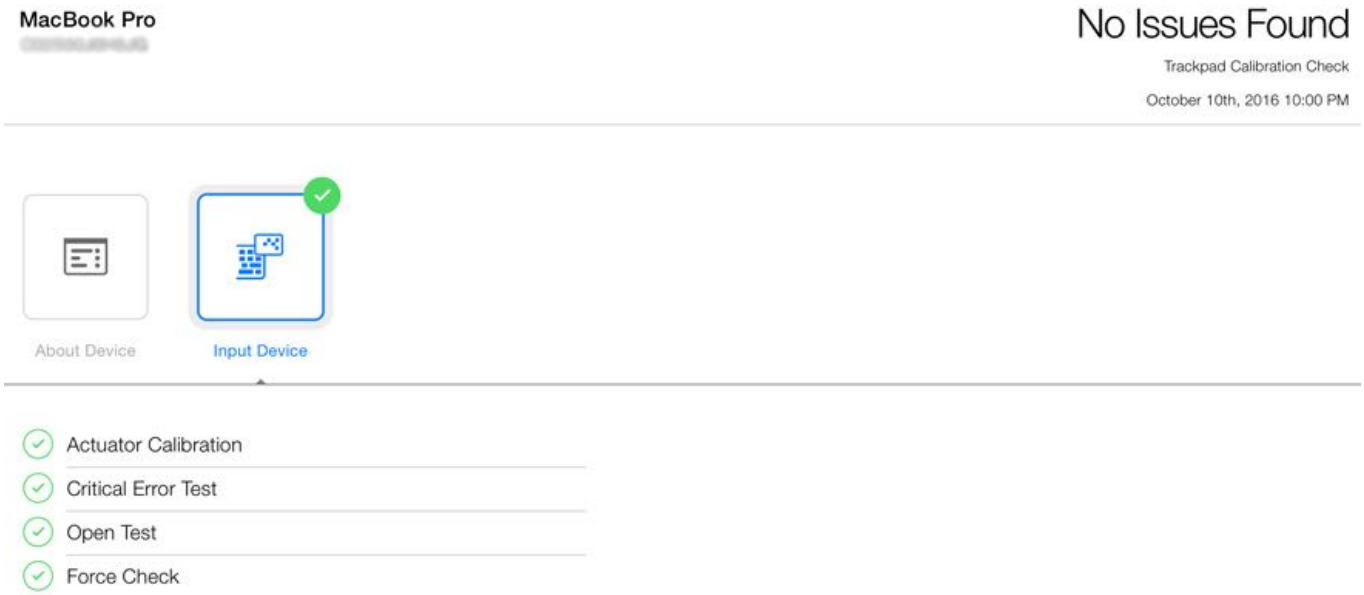
3. The diagnostic suite consists of several stages. The first stage of the suite is the Force Check, which is interactive and requires the technician to place the 200g and 800g weights as indicated. The blue dot will indicate where to place each weight on the trackpad. The text at the bottom of the screen will indicate which weight to use at each step. The dot will turn green when it is time to lift the weight from the trackpad.



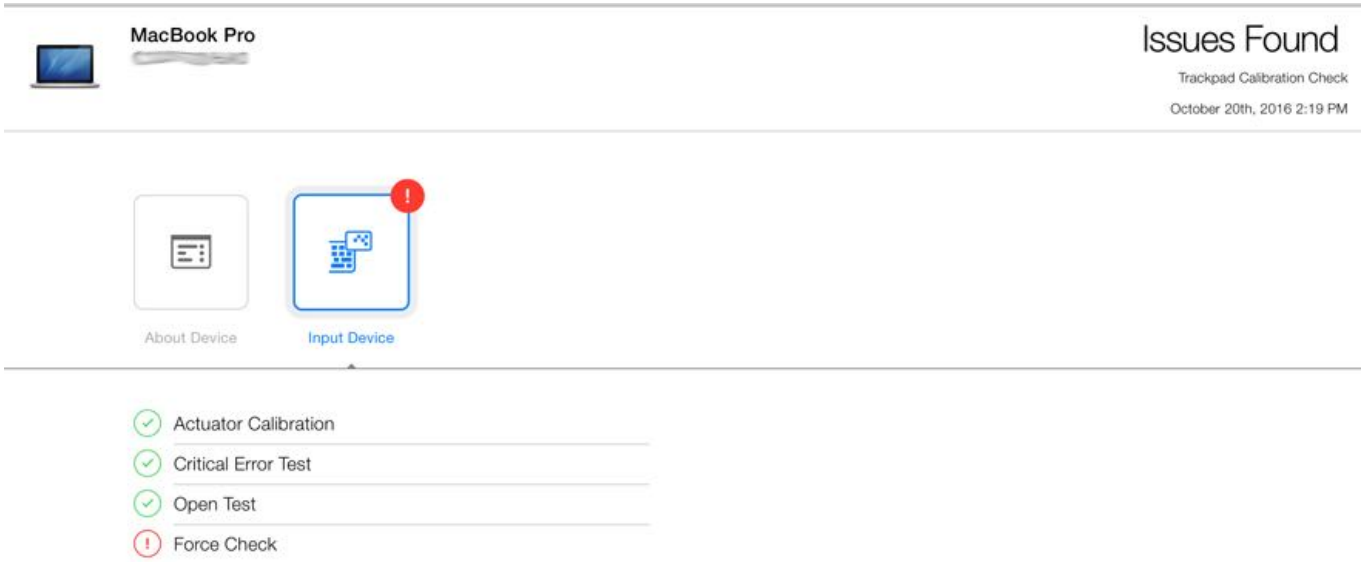


4. The next stage is the Actuator Check. During this stage, the trackpad will make clicking sounds while the actuator is tested. If any issues with the actuator are identified, the test may need to proceed to the next stage, which is the Actuator Calibration. The trackpad will continue to make clicking sounds while the actuator is calibrated. During this process, the unit under test (UUT) will display the screen shown below.

5. If no issues are found, the screen will look like the image below. The trackpad calibration is verified.



6. If issues were found in the Actuator Check, the Actuator Calibration, or the Force Check, the screen will look like the image below and the suite should be run again. If the computer fails a second time, a top case with keyboard replacement is recommended.



Connector Types on Logic Board

Connector Types on Logic Board for MacBook Pro (2016 and 2017)

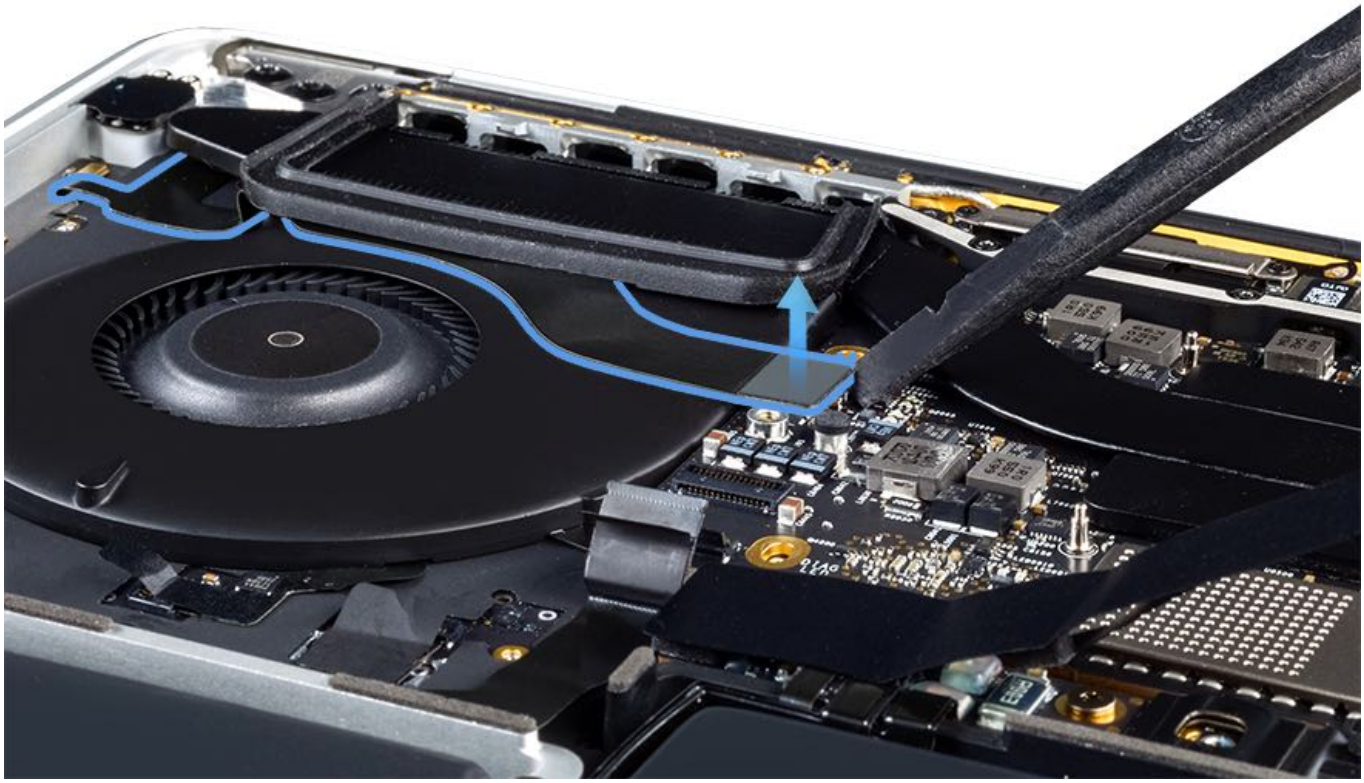
Low-Profile Solid Platform Flex

- Disconnect connector vertically in one motion. The connectors are susceptible to bent pins if rocked side-to-side or inserted improperly.
- Reconnect connector by first aligning it over receptacle. Keep connector level with board and press down evenly.

Example:

- audio flex cable
- trackpad flex cable
- Embedded DisplayPort (eDP) flex cable

Low-Profile Solid Platform Flex Video



Locking Lever

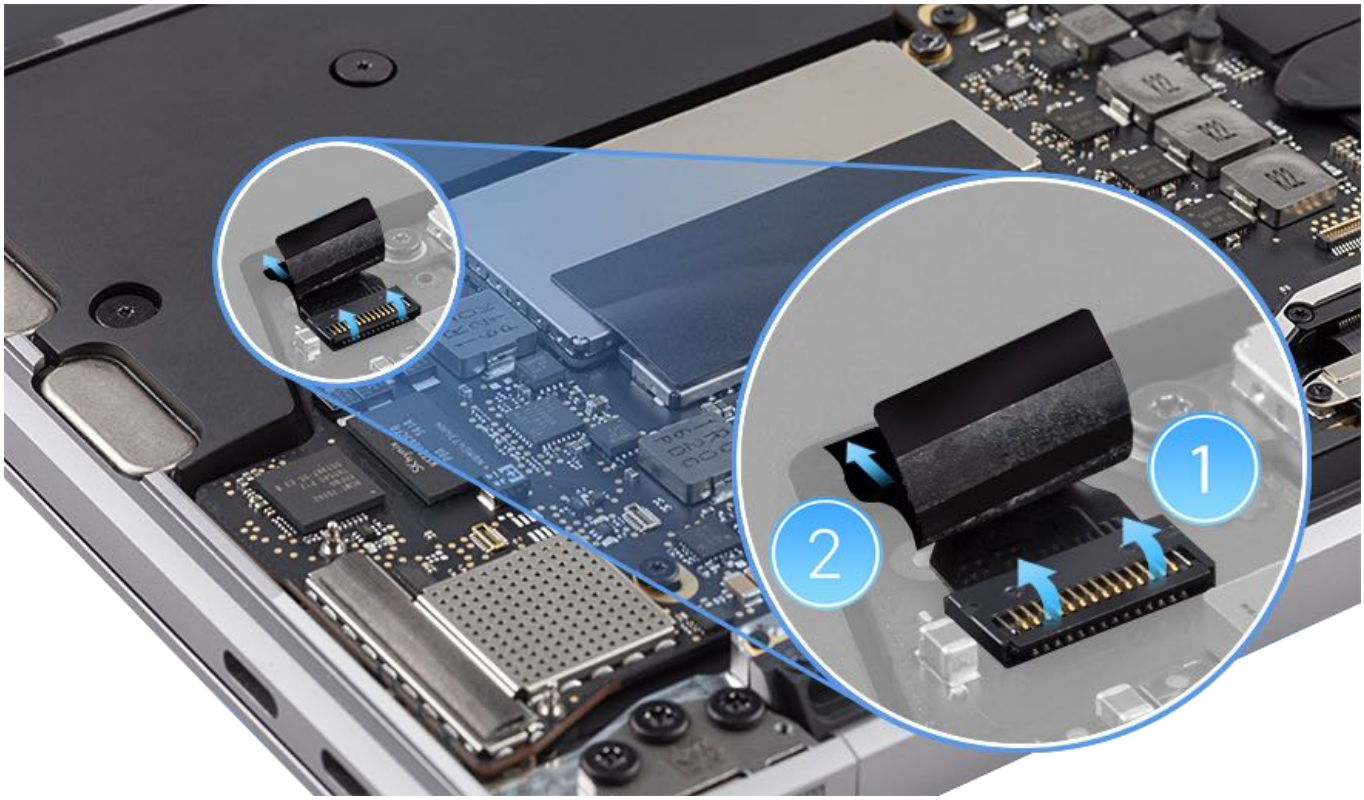
- Flip up lever 90 degrees and evenly disconnect cable.
- Lock down lever after inserting cable.
- Close lever when handling or shipping a logic board module, whether a known-good or a known-bad board.

Example:

- speakers
- keyboard flex cable
- fan
- battery flex cable

Caution: The locking levers on the logic board are fragile. To protect the levers during handling or shipment of the logic board, close the levers after the cables are disconnected. Once the logic board is installed in the top case and the cables are connected, be sure to lock down the levers again.

Locking Lever Video

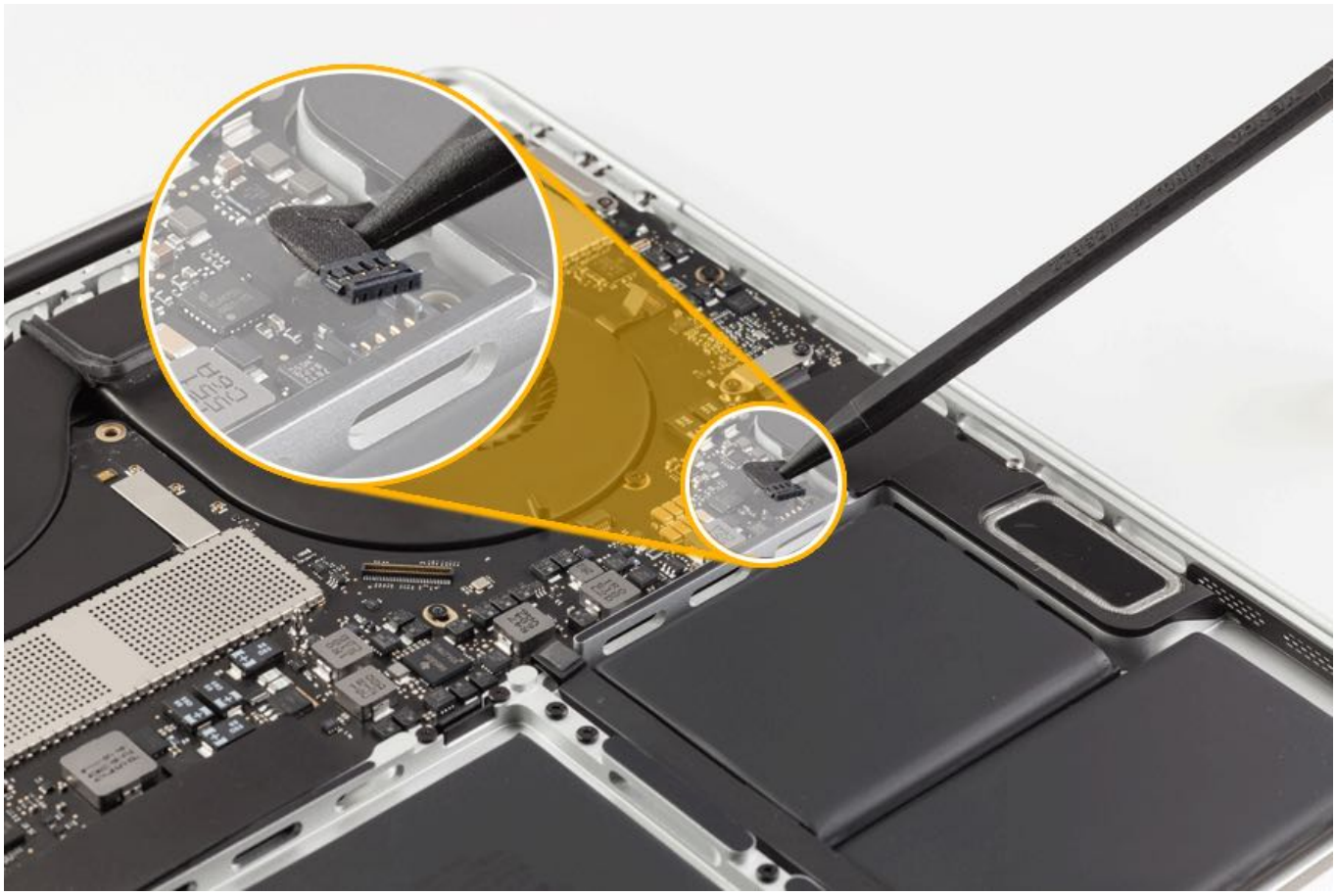


Vertical Insertion (JST)
MacBook Pro (15-inch, 2016 and 2017) only

Example:

- Use a black stick under the cable to remove.
- Keep the connector level to the board when disconnecting and reconnecting.
- Press evenly when reconnecting or connector can be tipped up and not fully seated.
    - Right speaker
    - Left speaker

Vertical Insertion (JST) Video



Tools and Fixtures

Tools and Fixtures for MacBook Pro (2016 and 2017)

The following tools are required:

- Clean, soft, lint-free cloth
- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags (for storing ESD-sensitive parts while removed from the unit)
- ESD-safe tweezers for wireless cables or antenna tool (923-01322)
- Suction cup (922-8252)
- Pentalobe screwdriver (923-0731)
- Torque driver (blue), 0.65 kg-fcm (923-0448)
- 1IPR security bit (923-0247), use with the Torque driver (923-0448)
- Torx T3 screwdriver (magnetized)
- Torx T4 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Black stick or other nonconductive nylon or plastic flat-blade tool (922-5065)
- Thermal grease syringe (922-7144)
- Isopropyl alcohol (IPA) wipe (included with heat sink and logic board)
- Magnifying glass (for reading serial number)
- Keycap lever (923-01803)
- Keycap tool kit (076-00337) includes: Keycap slider tool, keycap lever, Kapton tape, and pre-cut VHB adhesive strips.

Caution: To prevent scratches or other cosmetic damage to the computer housing, use a soft cloth as a protective layer when removing and installing the external screws.

Bottom Case Fixture

- Bottom case removal/install fixture kit (076-00290), which includes:
  - Bottom case fixture
  - Quick grip clamps (2), also available separately (923-01369)
  - Non-slip gloves, small (pair), also available separately (923-01371)
  - Non-slip gloves, extra large (pair), also available separately (923-01370)

- Non-slip gloves, medium/large (pair), only available separately (923-01368), not part of the kit

Battery Covers

MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **923-01318**

MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): **923-01319**

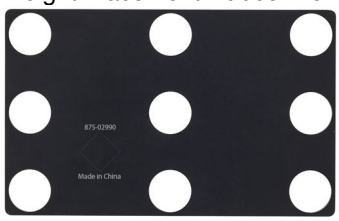
MacBook Pro (15-inch, 2016 and 2017)**: 923-01320**

Trackpad Tools

- Trackpad calibration weights (923-00462)

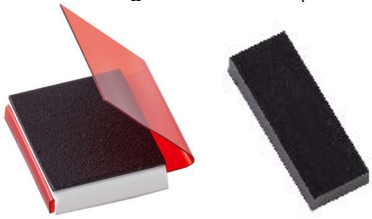
- Weight Placement Rubber Template (923-01316) for MacBook Pro (13-inch, 2016 and 2017)

- Weight Placement Rubber Template (923-01317) for MacBook Pro (15-inch, 2016 and 2017)



Other Tools for MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016 and 2017)

- Touch ID alignment tool kit (923-01586)



- Data transfer tool kit (076-00236)

- Logic board holder (923-01130)

Take Apart Procedure Notes

Reassembly Steps

When no replacement steps are listed, replace parts in exact reverse order of Removal procedure.

Note About Images in This Guide

In some cases a pre-production model may have been used to document the procedures in this guide. Although there may be small differences in appearance between the image pictured and the computer you are servicing, the procedures are the same unless noted.

Screw Sizes

All screw sizes shown are approximate and represent the total length of the screw.

Bottom Case

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Follow ESD guidelines. Refer to article OP100: Electrostatic Discharge Precautions and Myths.
- Read article TP772: Battery Safety Setup before performing this procedure.

Before you begin:

- Disable the auto boot features. Refer to article TP1484: Auto Boot.
- Shut down the computer.
- Unplug all cables.
- Once the display has turned off, press the Caps Lock key and verify that the LED does not turn on.
- Put on an ESD wrist strap.
- Place the computer face down on a clean, flat surface.

For video instruction, refer to article SV306: Bottom Case Replacement Video.

Tools

- ESD wrist strap
- Clean, soft, lint-free cloth
- Pentalobe screwdriver (923-0731)

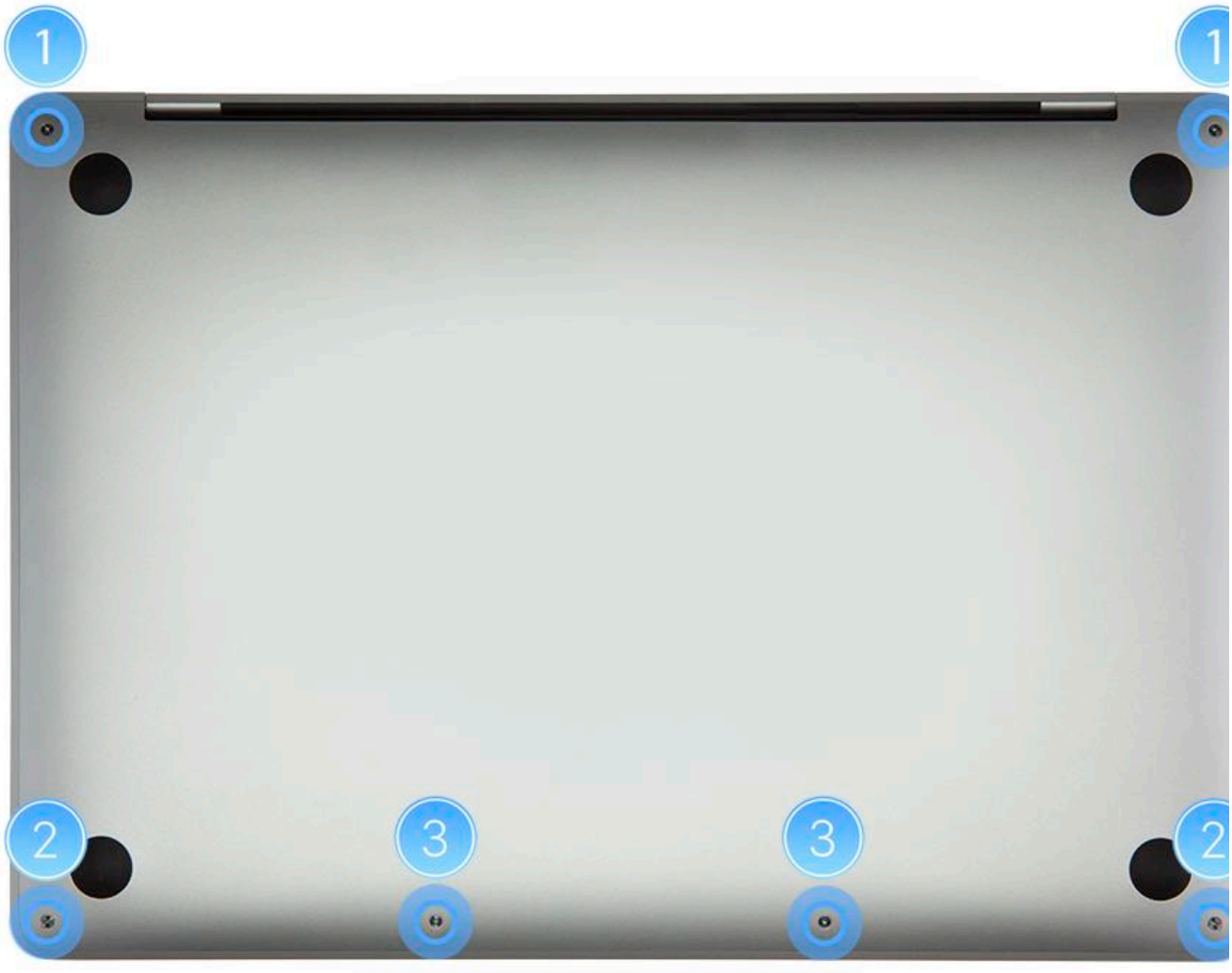
- Battery cover:
  - 923-01318 for MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)
  - 923-01319 for MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports)
  - 923-01320 for MacBook Pro (15-inch, 2016 and 2017)
- Bottom case removal/install fixture kit (076-00290)
- Fine-tip permanent marker
- Suction cup (922-8252)

Steps For Removal

1. Remove the six Pentalobe screws following any sequence. The difference in screw lengths is only important when replacing them.
   Note: In the following table, "2 TBT3" refers to the MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports) models, and "4 TBT3" refers to the MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) models.

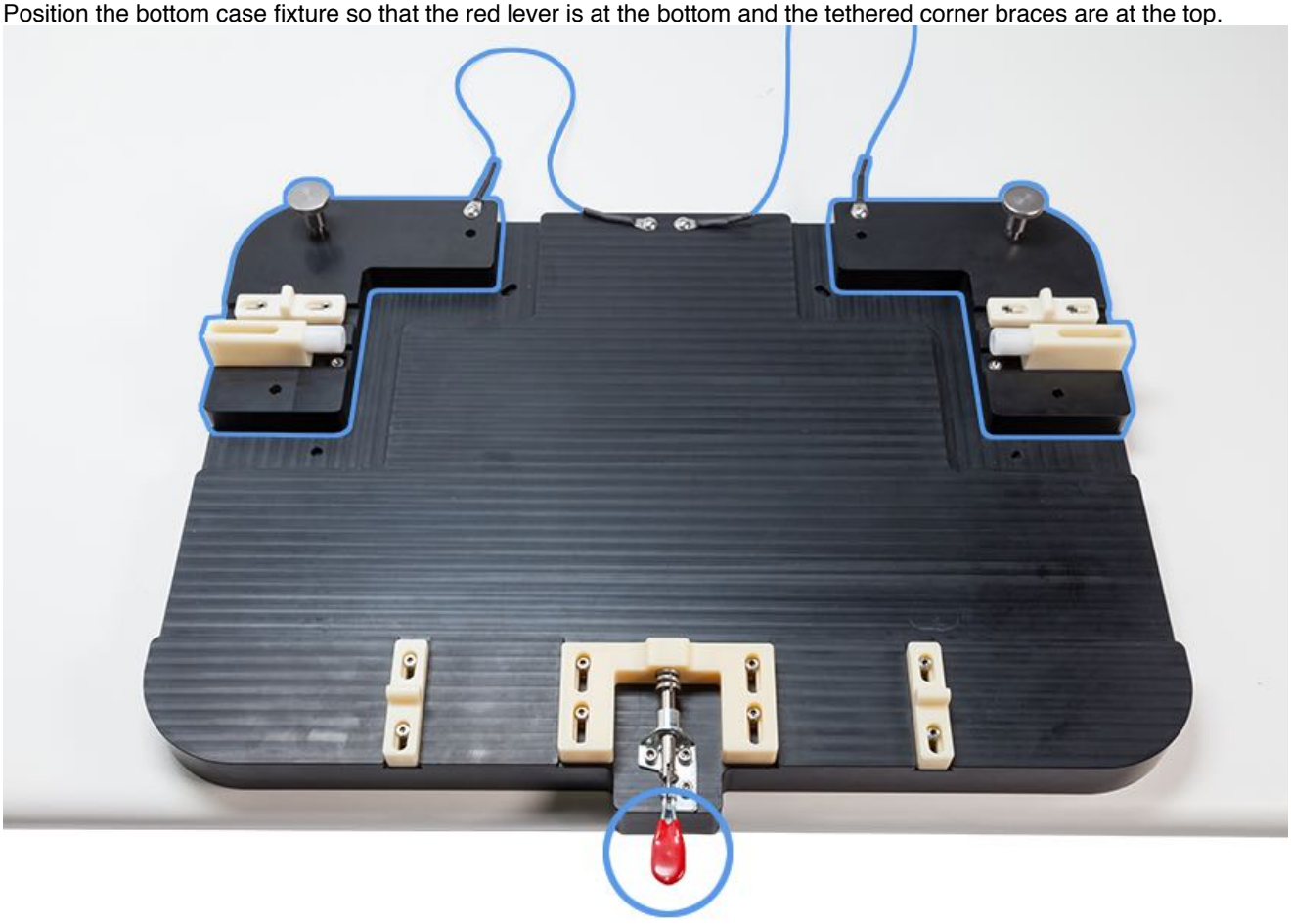
	Screw #1	Screw #2	Screw #3
13-inch, 2 TBT3 Space Gray	923-01299 	923-01097 	923-01095 
13-inch, 2 TBT3 Silver	923-01099 	923-01100 	923-01098 
13-inch, 4 TBT3 Space Gray	923-01096 	923-01413 	
13-inch, 4 TBT3 Silver	923-01415 	923-01431 	
15-inch Space Gray	923-01514 	923-01513 	
15-inch Silver	923-01517 	923-01516 	

MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)

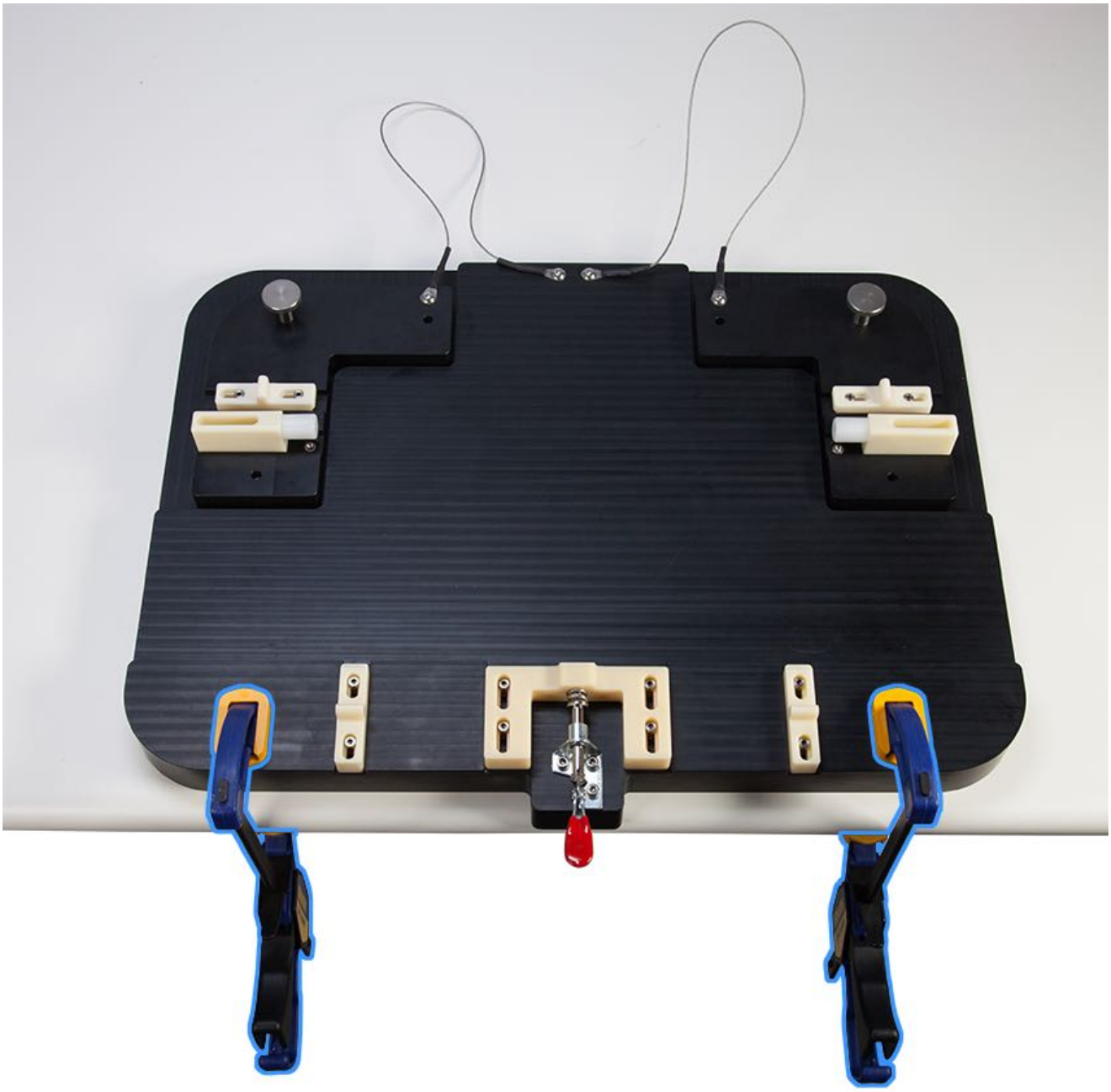


MacBook Pro (13-inch, 2016, and 2017 Four Thunderbolt 3 Ports) and (15-inch, 2016 and 2017)

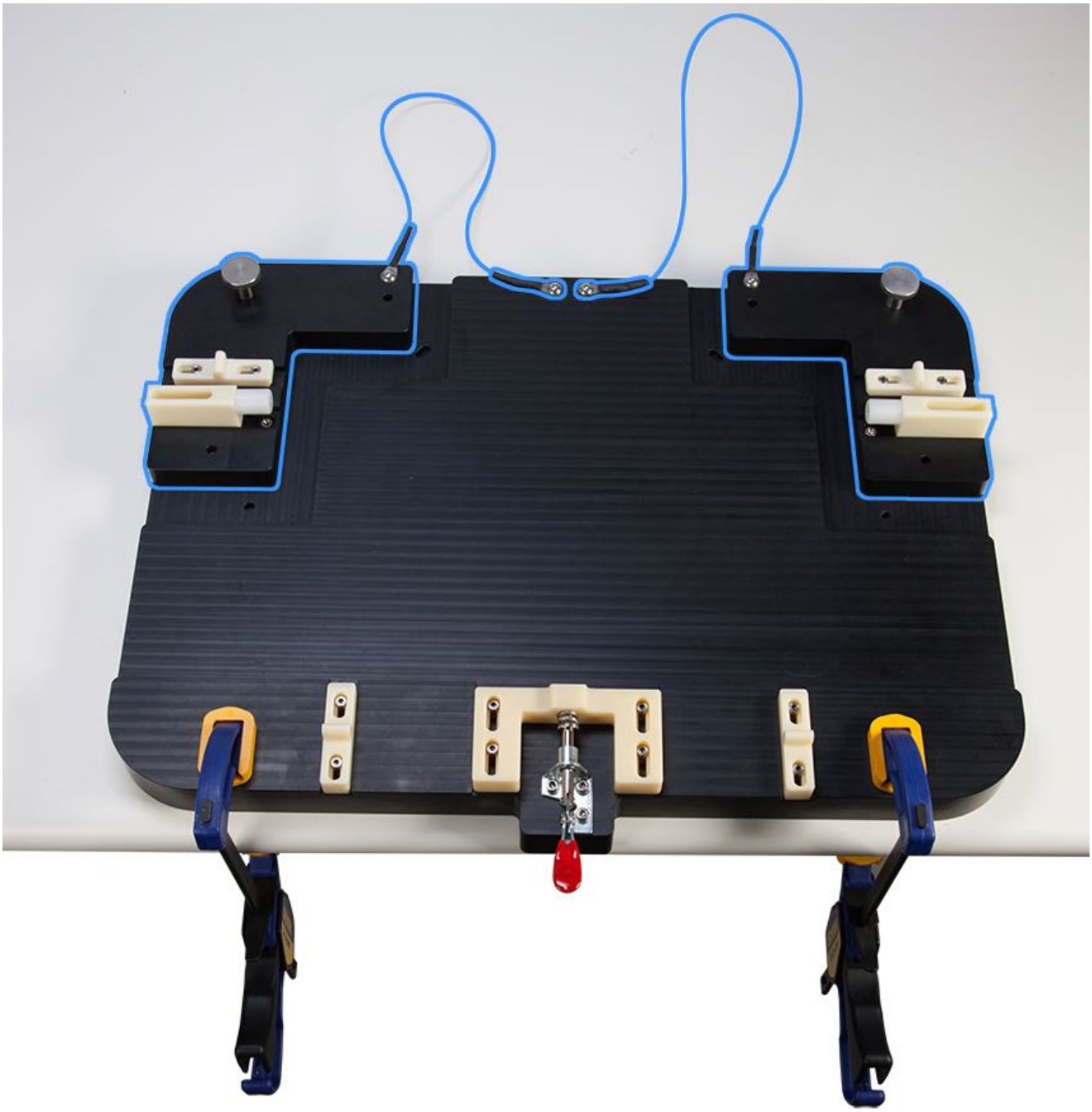
2. Position the bottom case fixture so that the red lever is at the bottom and the tethered corner braces are at the top.



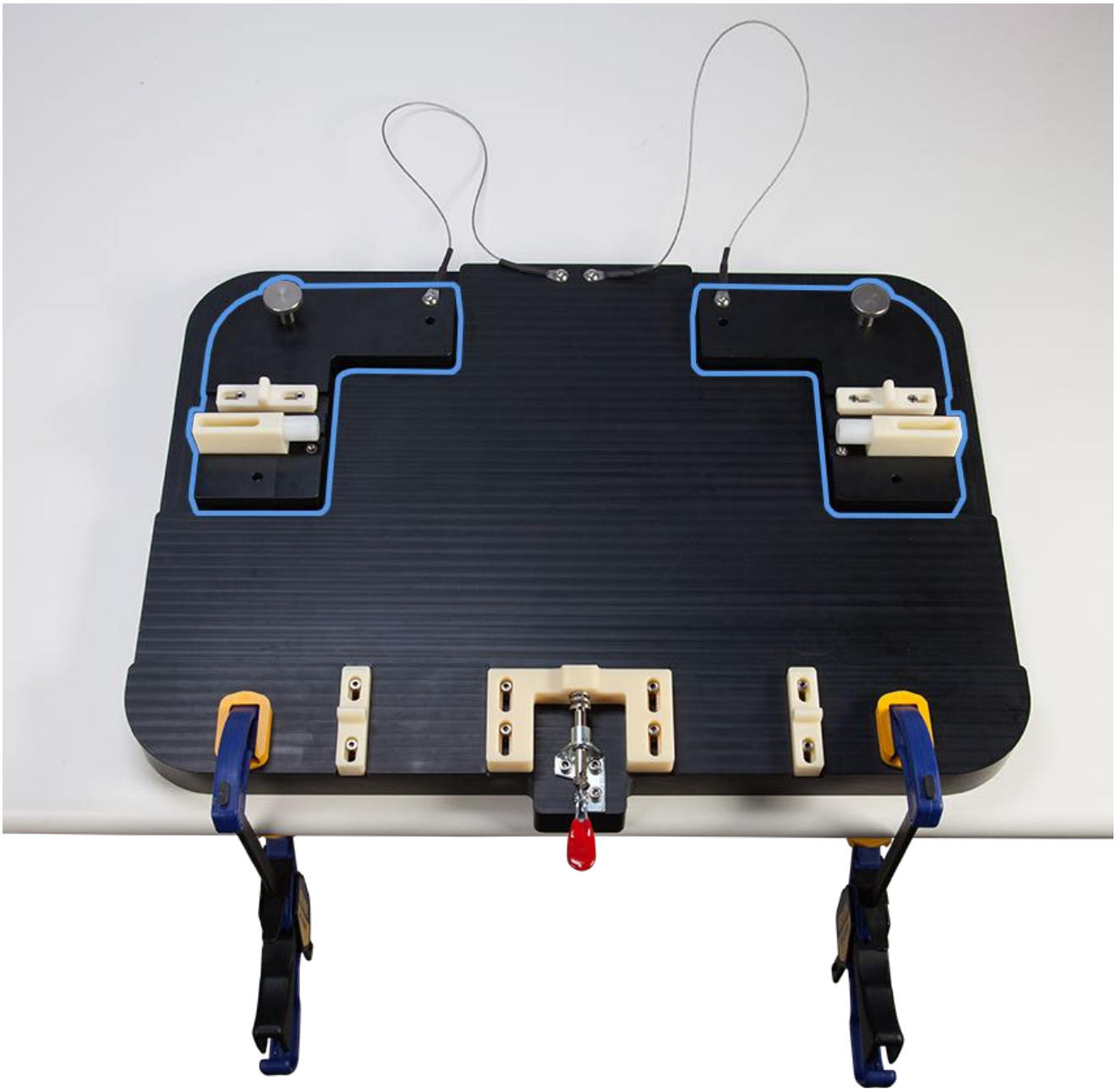
3. Use two Quick Clamps to secure the bottom case fixture to the table. Squeeze the clamp handles to tighten them. Make sure that the sliding bars of the clamps are below the table.



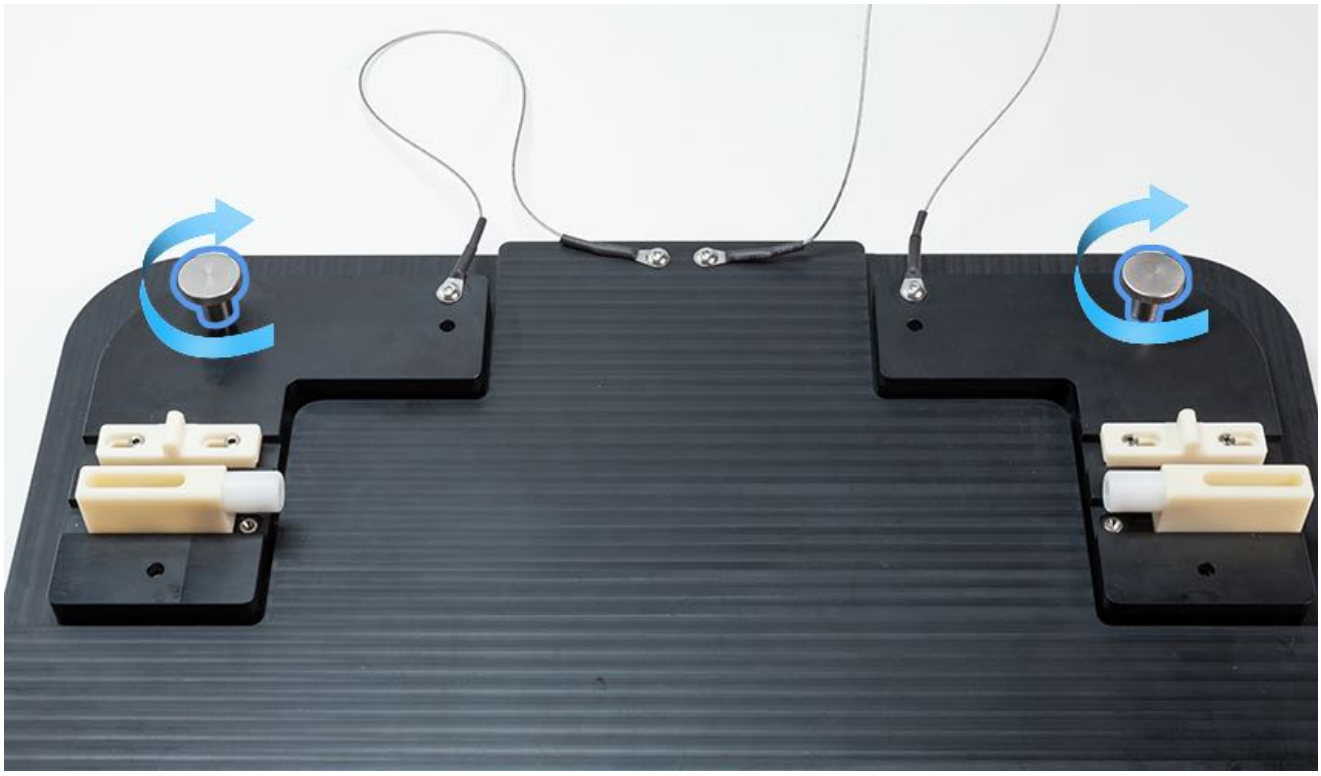
4. Unscrew and position the corner braces to accommodate either a 13-inch or 15-inch computer. Move the braces outward for a 15-inch model, as shown.



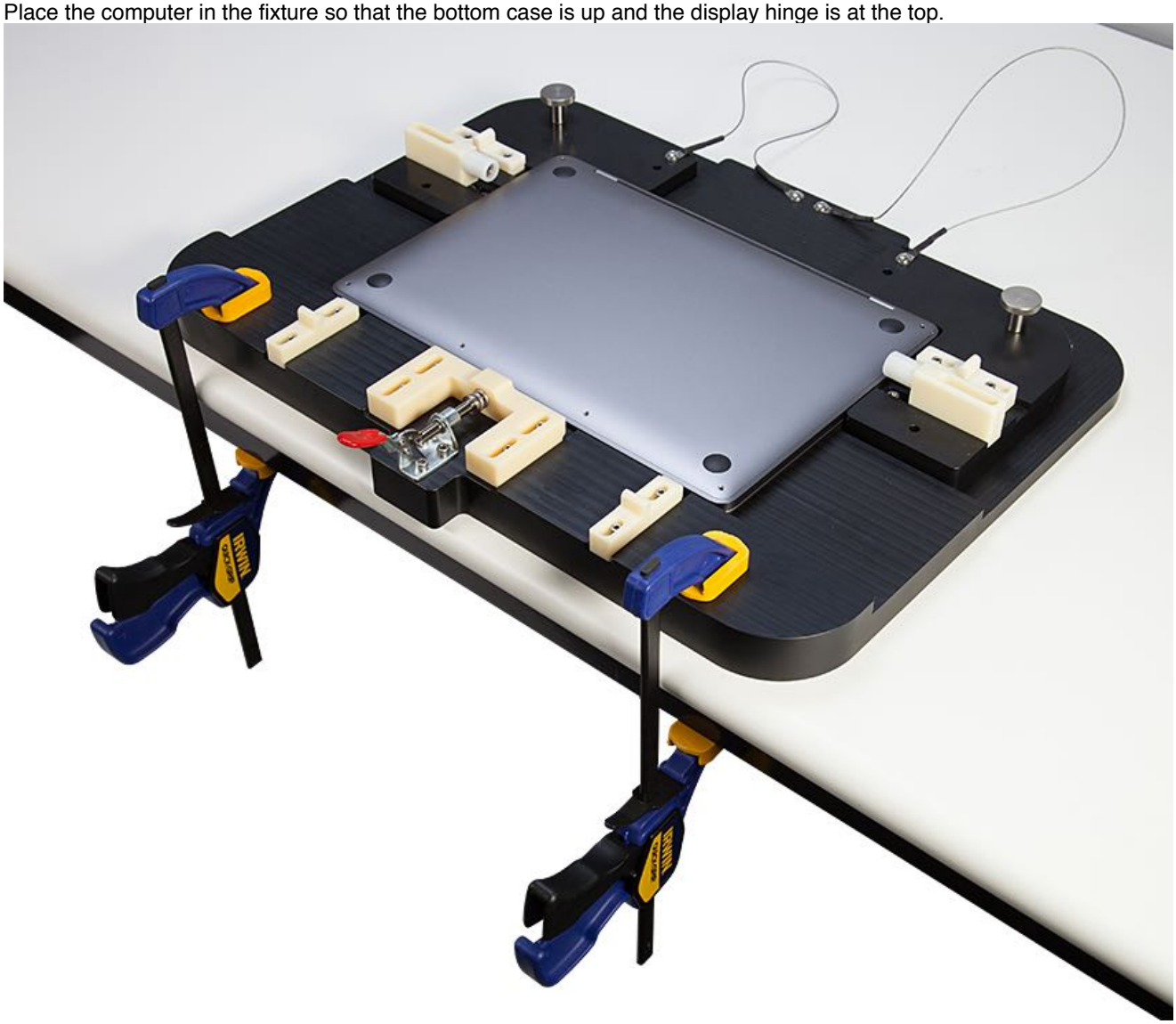
5. Move the braces inward for a 13-inch model, as shown.



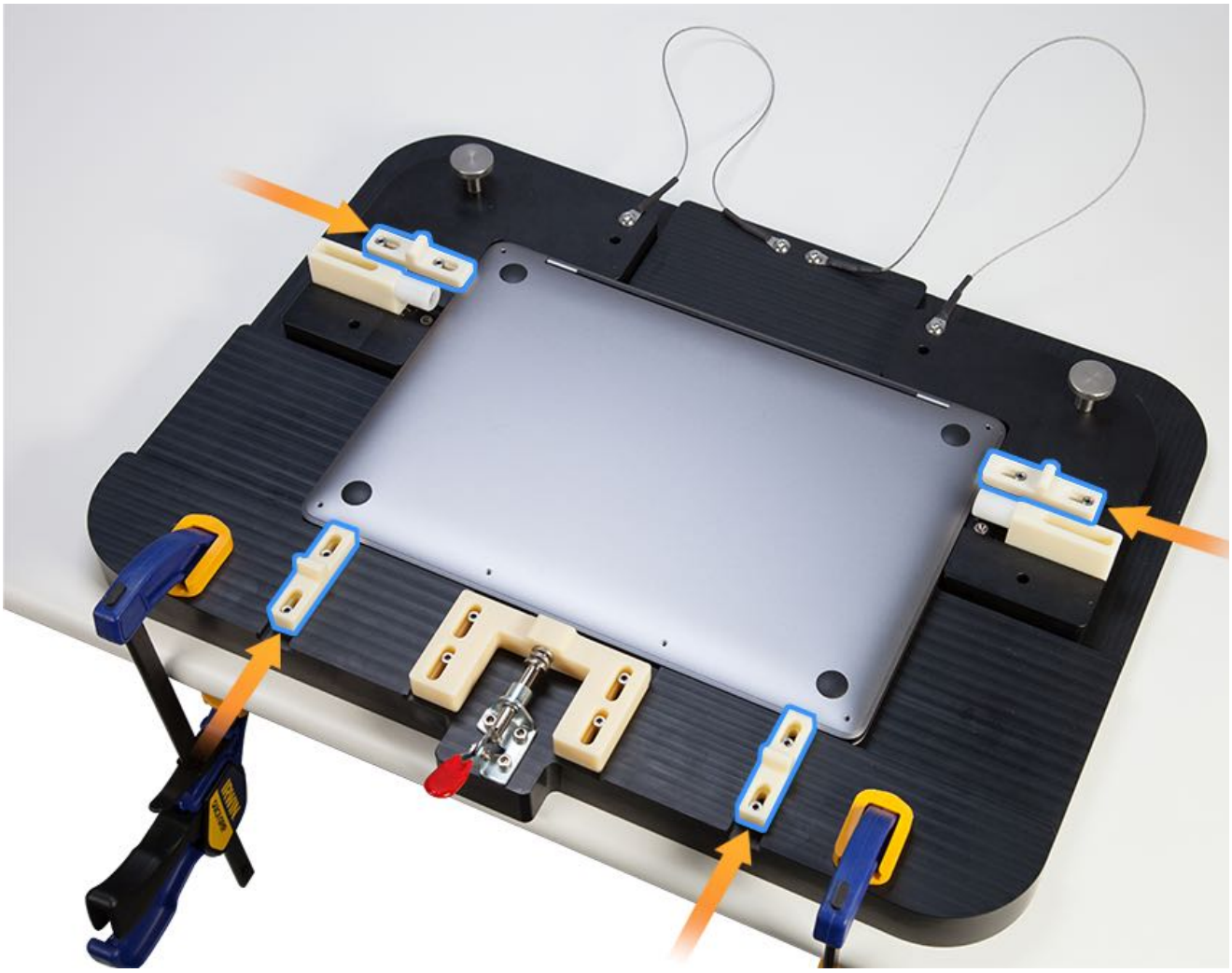
6. Once the corner braces are set, tighten the silver thumbscrews.



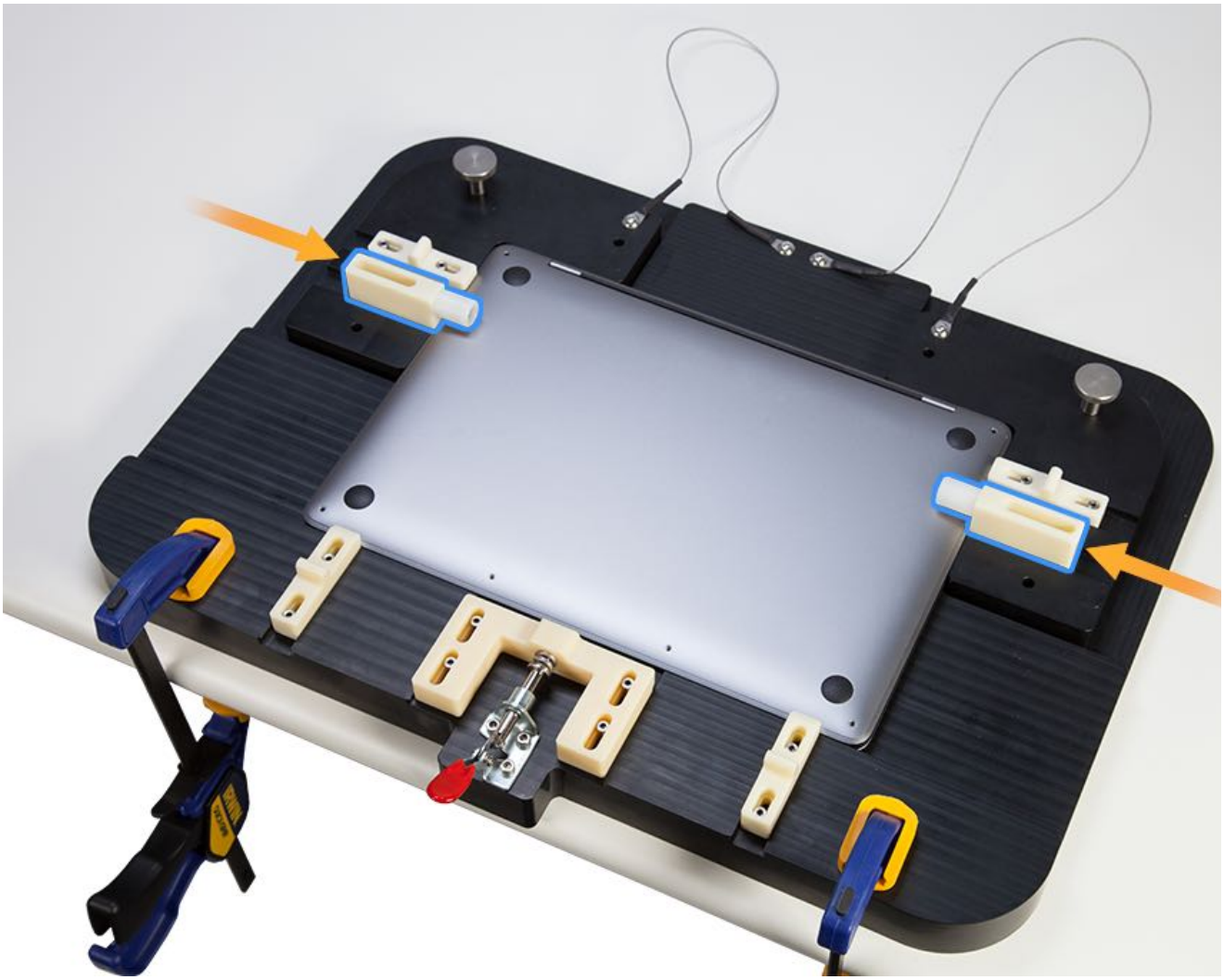
7. Place the computer in the fixture so that the bottom case is up and the display hinge is at the top.



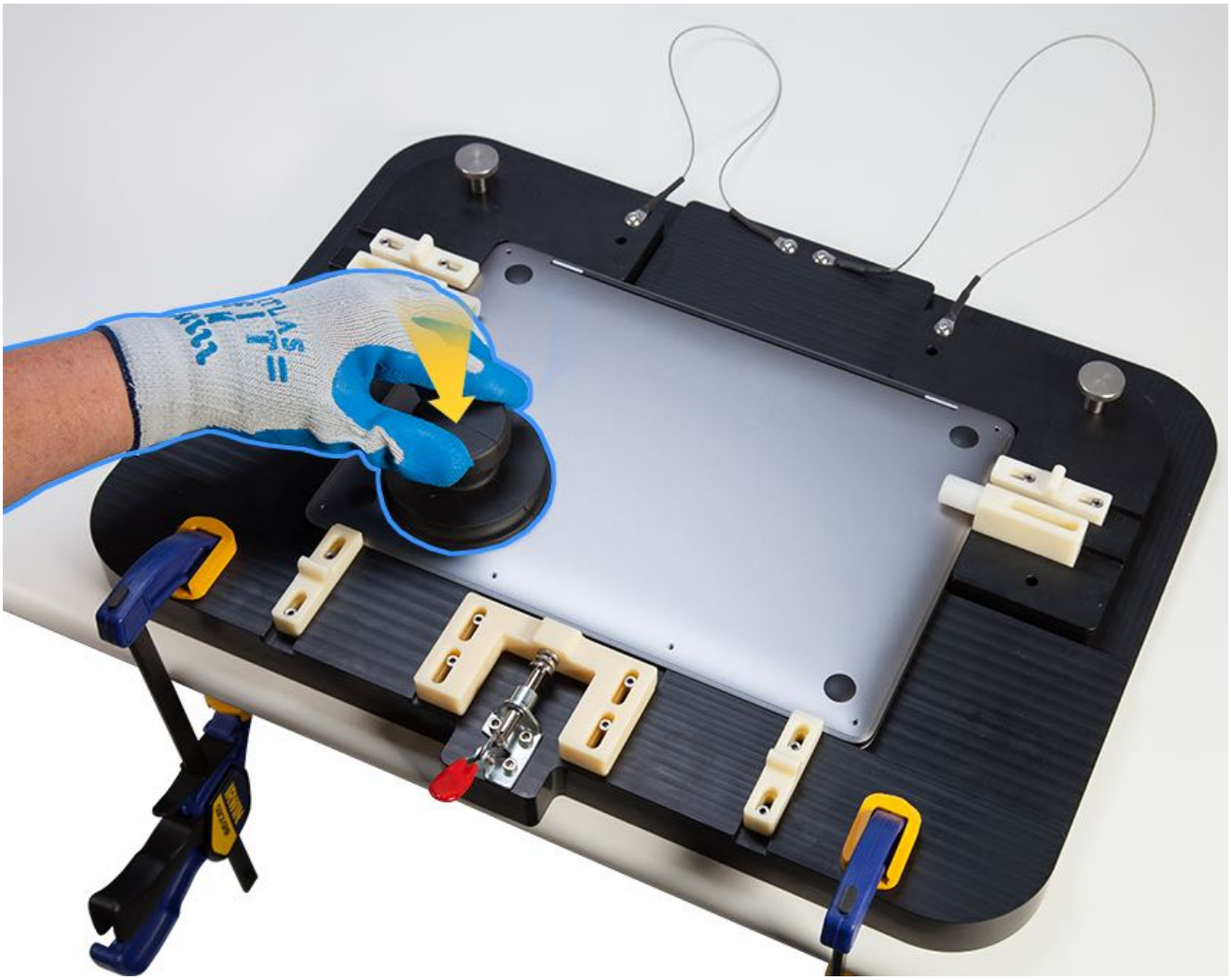
8. Push the four sliding locks inward to hold the computer in place.



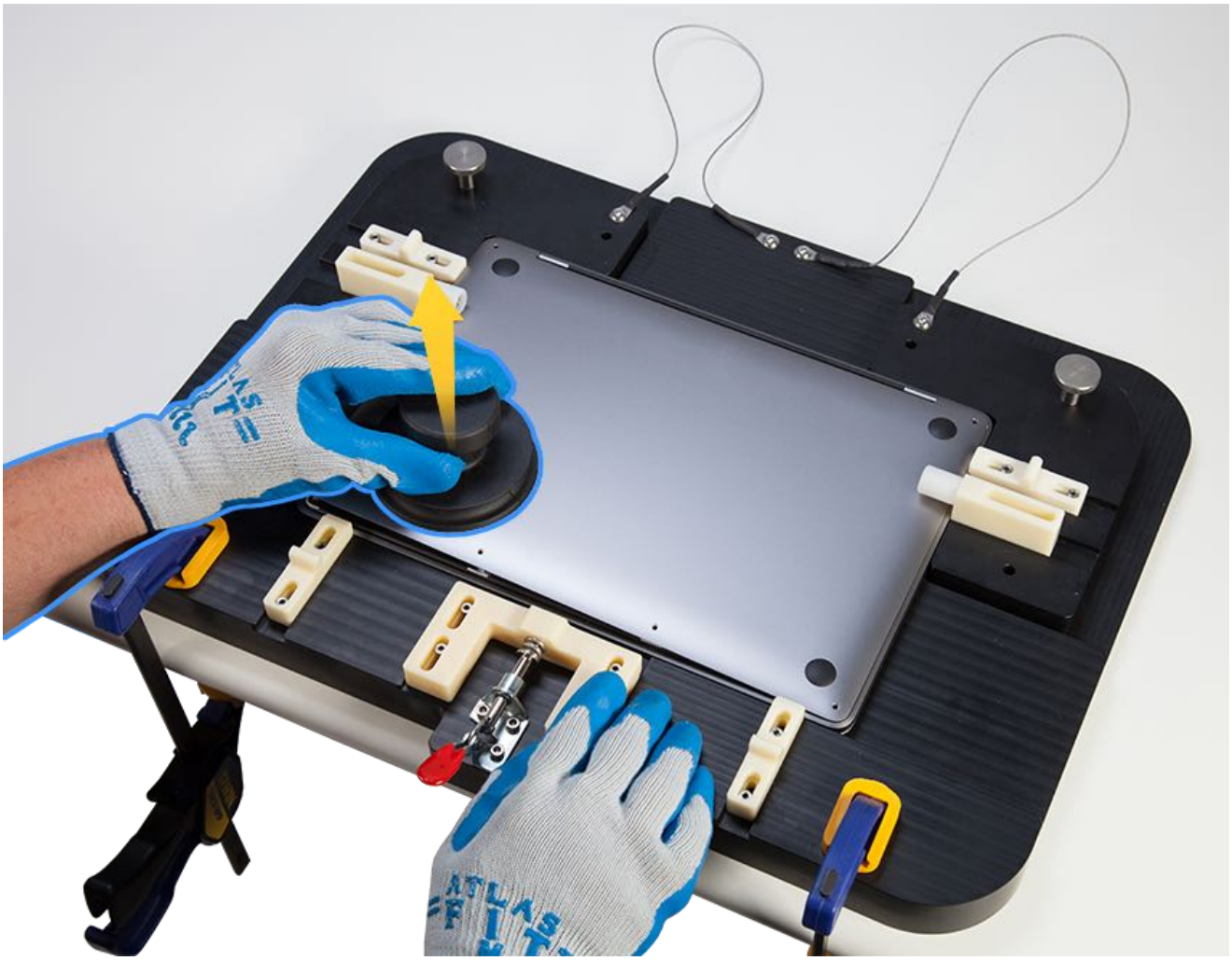
9. Press the two rollers inward. They prevent the bottom case from tilting upwards too far.



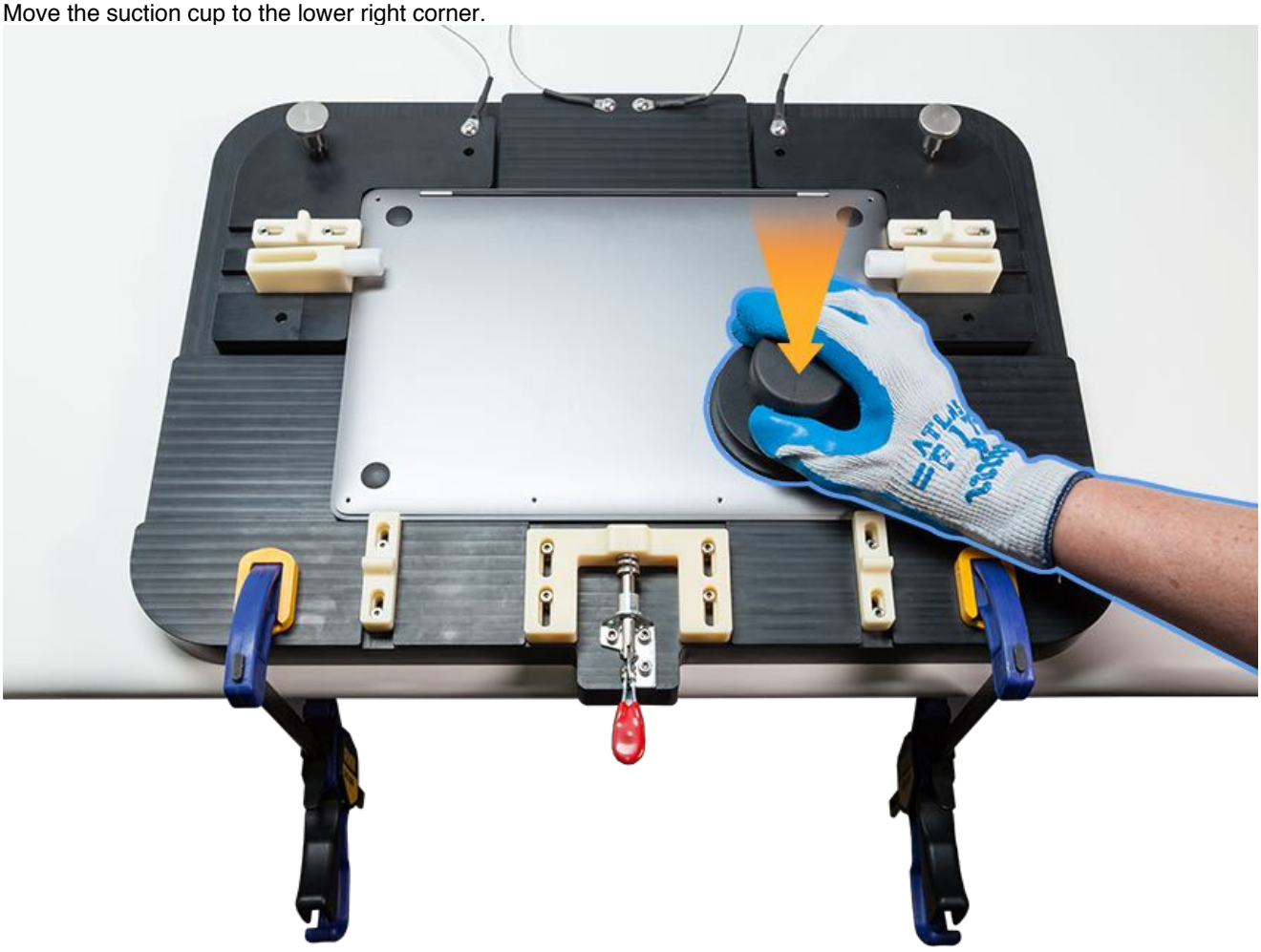
10. Put on the pair of gloves and attach the suction cup at the lower left edge of the bottom case.



11. Pull up on the suction cup about half a centimeter (0.5 cm), just high enough to lift the bottom case and release two snaps.
    Caution: Do NOT insert a black stick into the opening. Using a black stick could damage the battery.



12. Move the suction cup to the lower right corner.

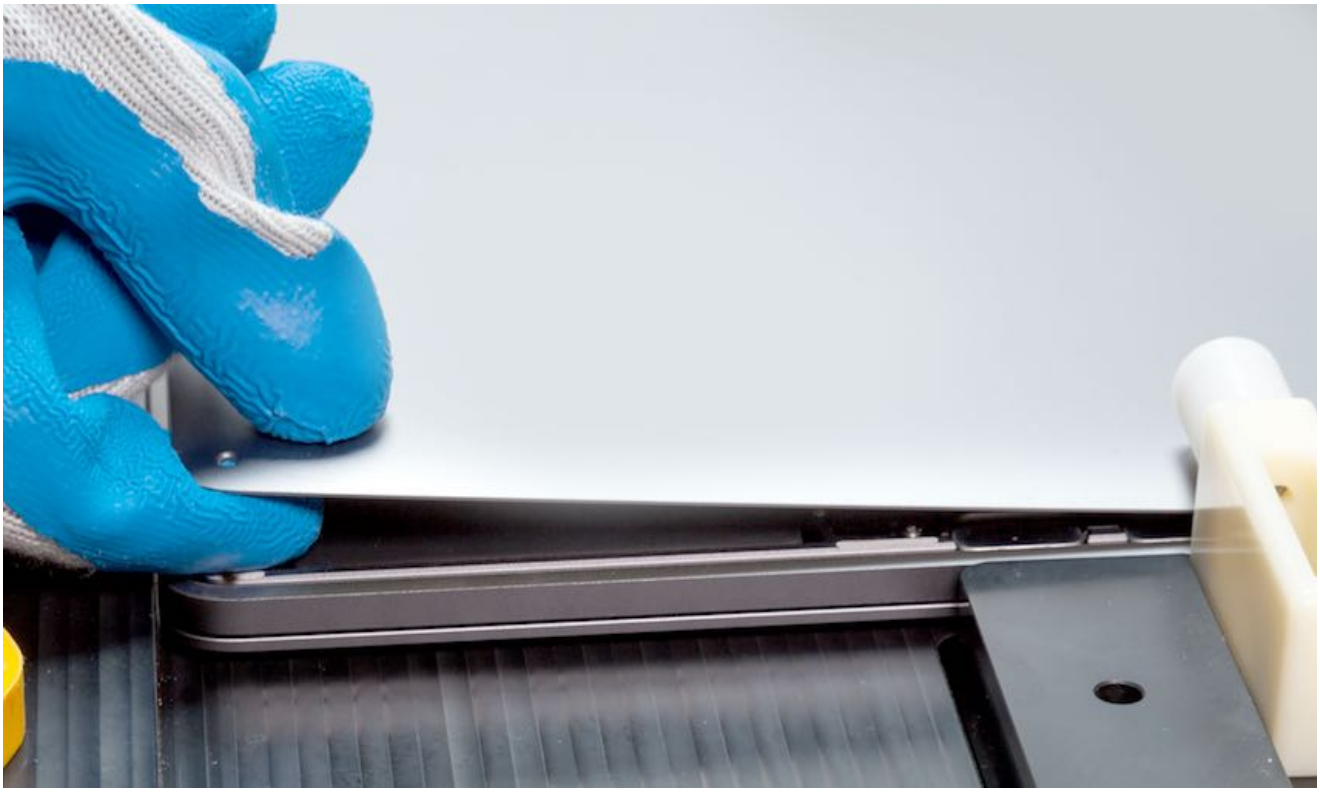


Pull up the suction cup to release the remaining two snaps.

13.

14. Remove the suction cup. Then insert your index fingers into the narrow opening at the front of the computer.

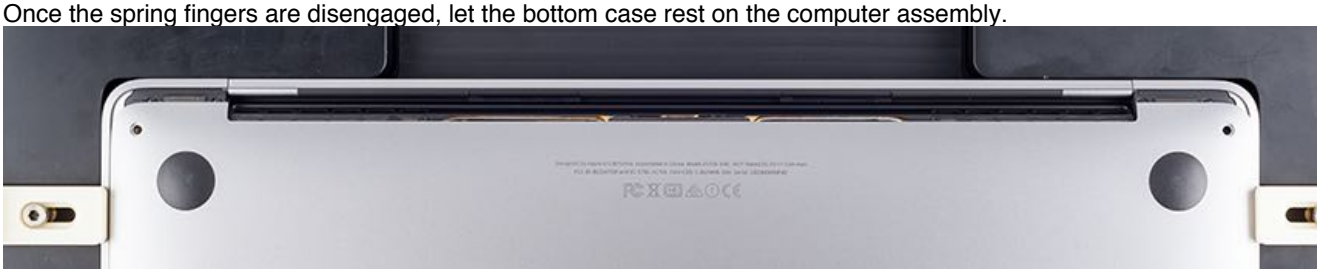
15. To protect the computer assembly, keep the opening no more than a finger's width.



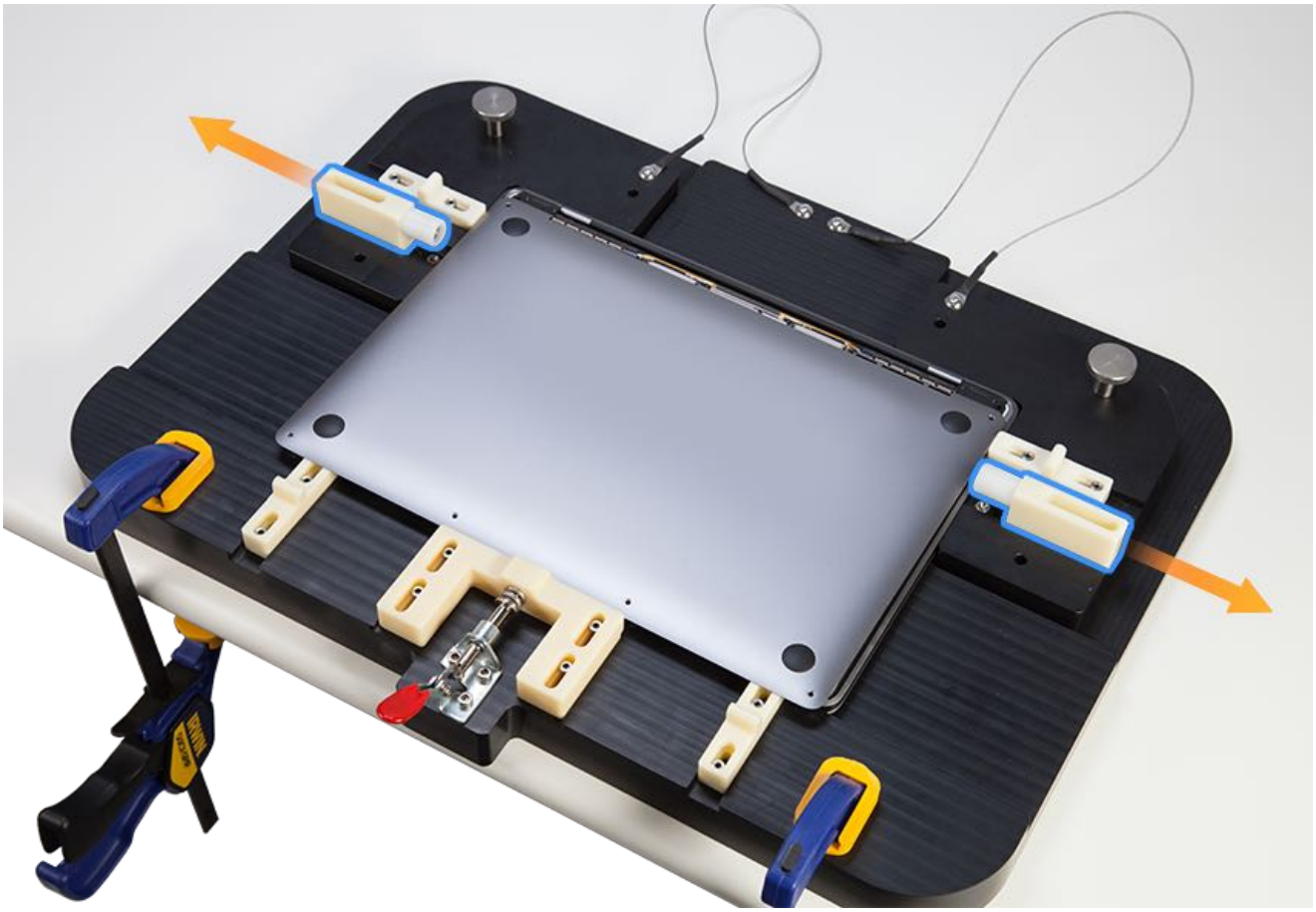
16. Position both hands so that they are braced in the recessed areas of the fixture. Bracing your hands allows more leverage and protects the internal components when you remove the bottom case.

17. Pull the bottom case toward you.
Caution: The spring fingers that secure the bottom case can release suddenly. To prevent the bottom case from sliding over sensitive components, apply gentle and steady pressure to slide the case less than one centimeter (< 1 cm).

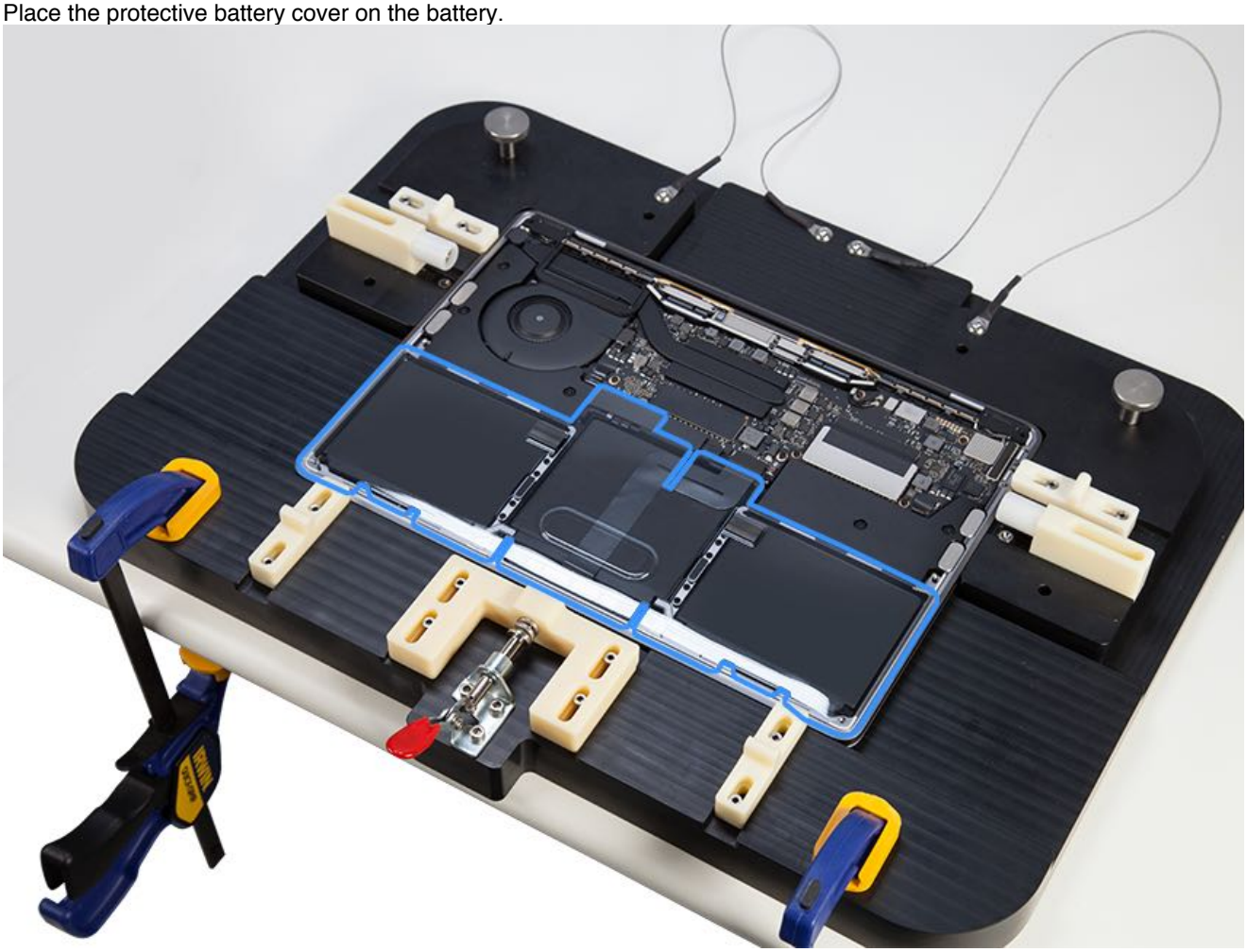
18. Once the spring fingers are disengaged, let the bottom case rest on the computer assembly.



19. Remove the gloves and disengage the two rollers.
20. Remove the bottom case from the fixture.

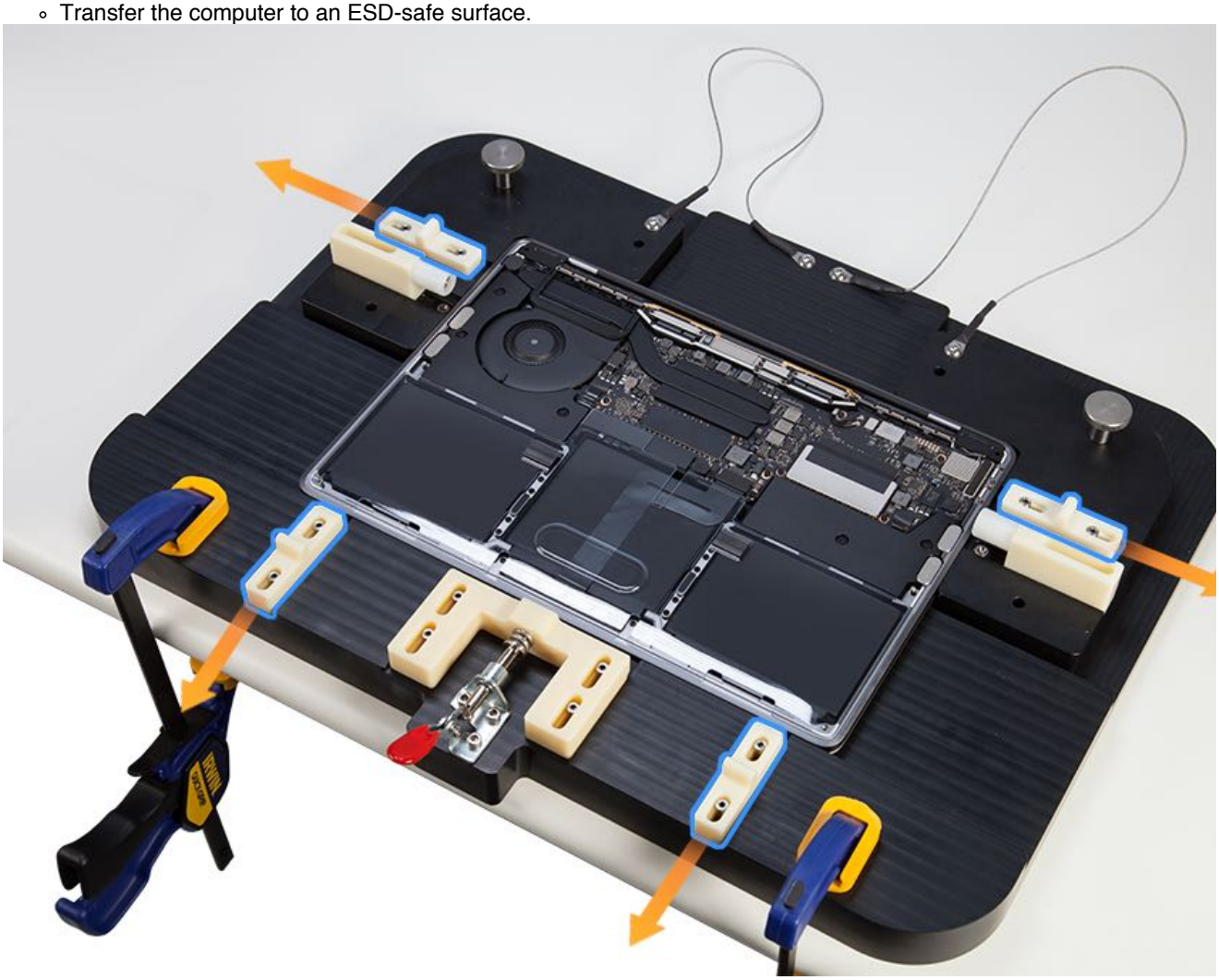


21. Place the protective battery cover on the battery.



22. If you are replacing just the bottom case, go to the Reassembly instructions. If you are performing an additional repair on the computer, do not perform that repair while the unit is on the bottom case fixture. Instead, do the following:
    - Release the four sliding locks, then lift the computer from the bottom case fixture.

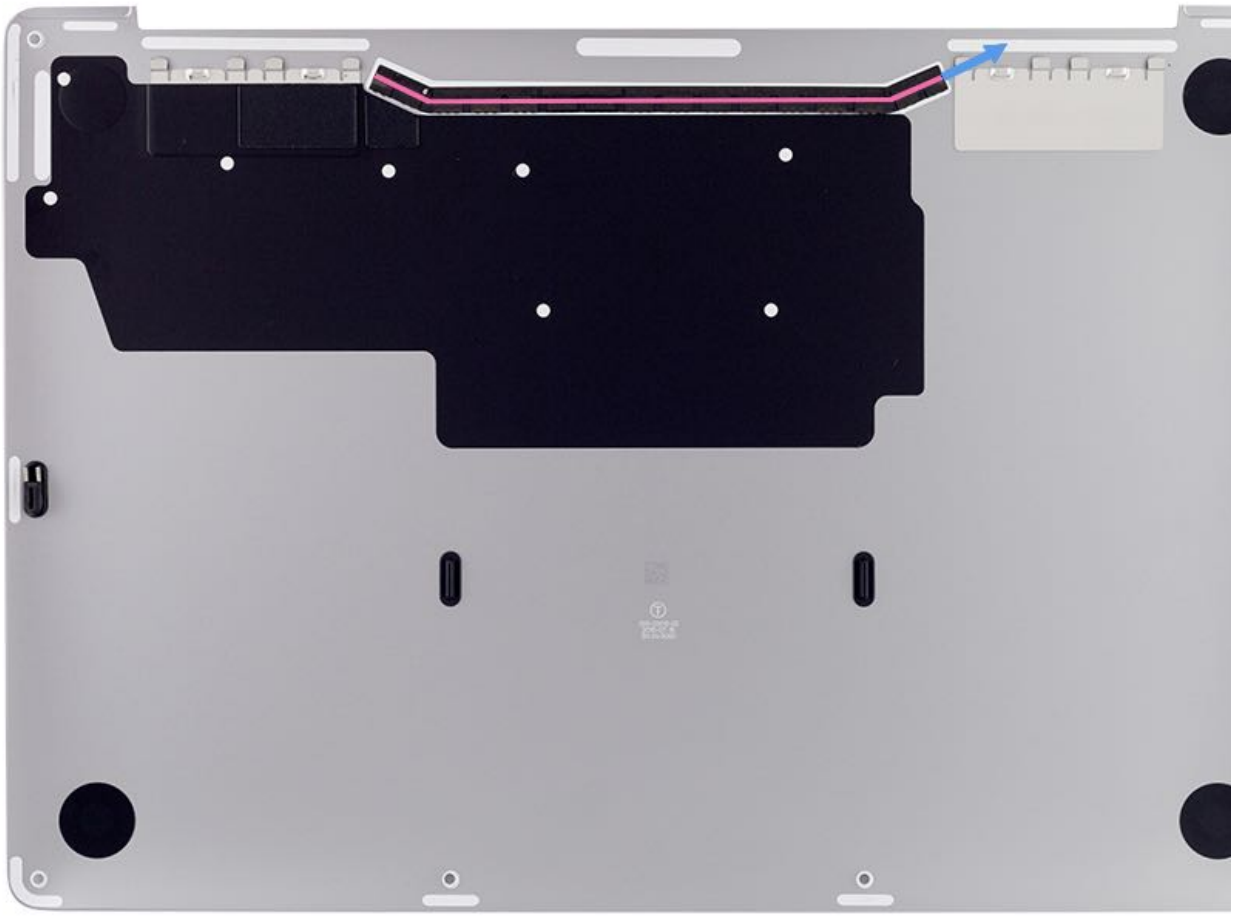
- Transfer the computer to an ESD-safe surface.



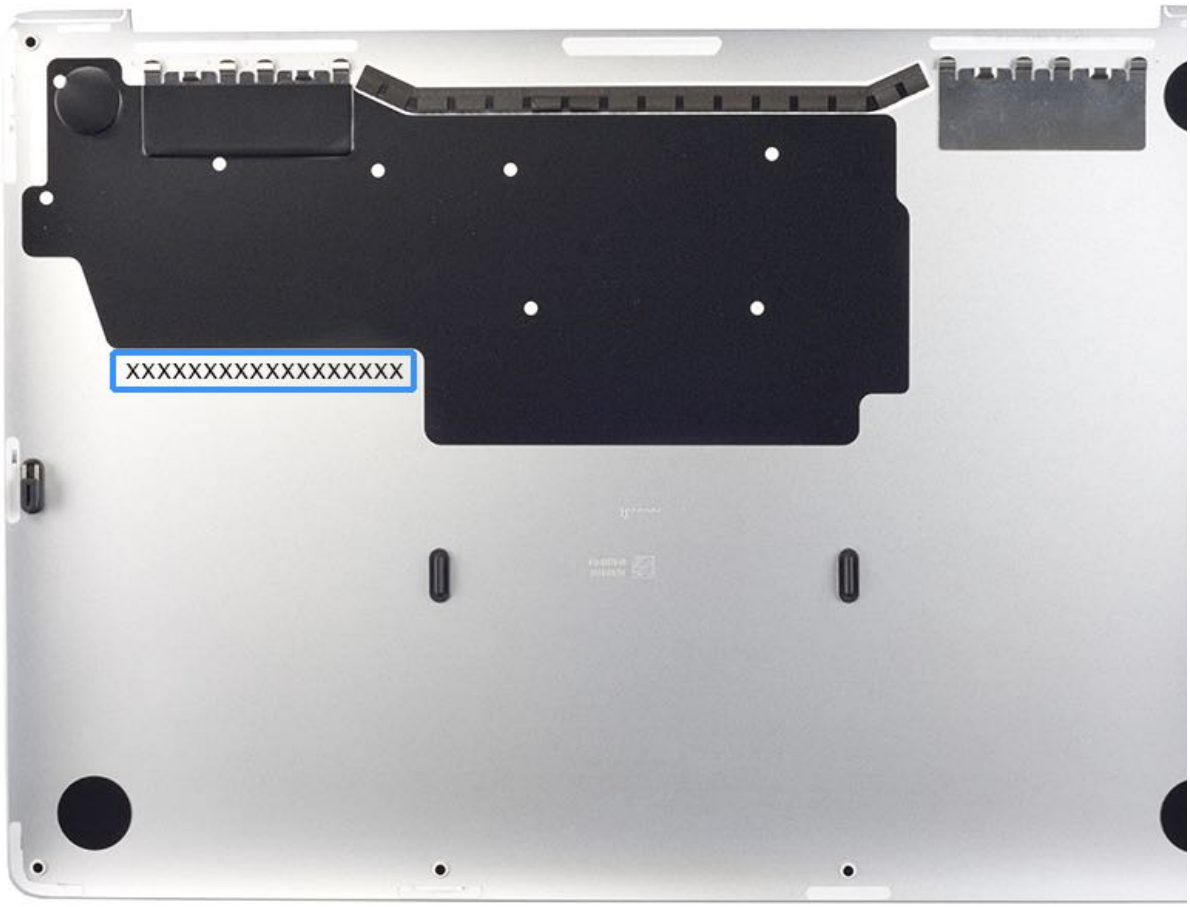
23. Refer to one of the following articles to disconnect the battery:
    - MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): Battery Cover and Disconnecting the Battery
    - MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports): Battery Cover and Disconnecting the Battery
    - MacBook Pro (15-inch, 2016 and 2017): Battery Cover and Disconnecting the Battery

Steps For Reassembly

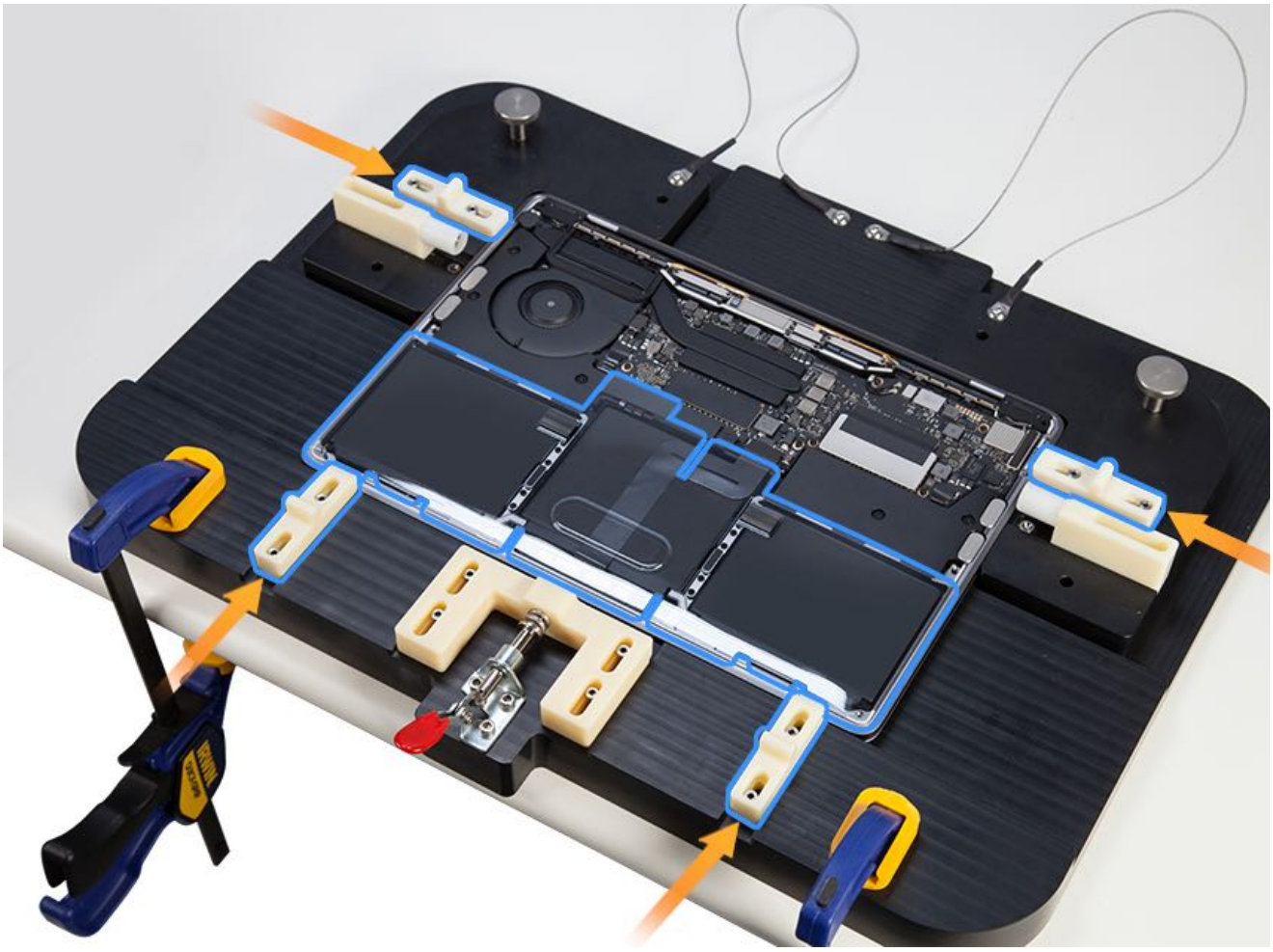
1. Before installing a new bottom case, do the following:
    - Check the replacement bottom case for a red tube that runs through the air loops. Grasp one end of the red tube and pull it out of the air loop strip. The tube is used only during shipment and should be discarded.



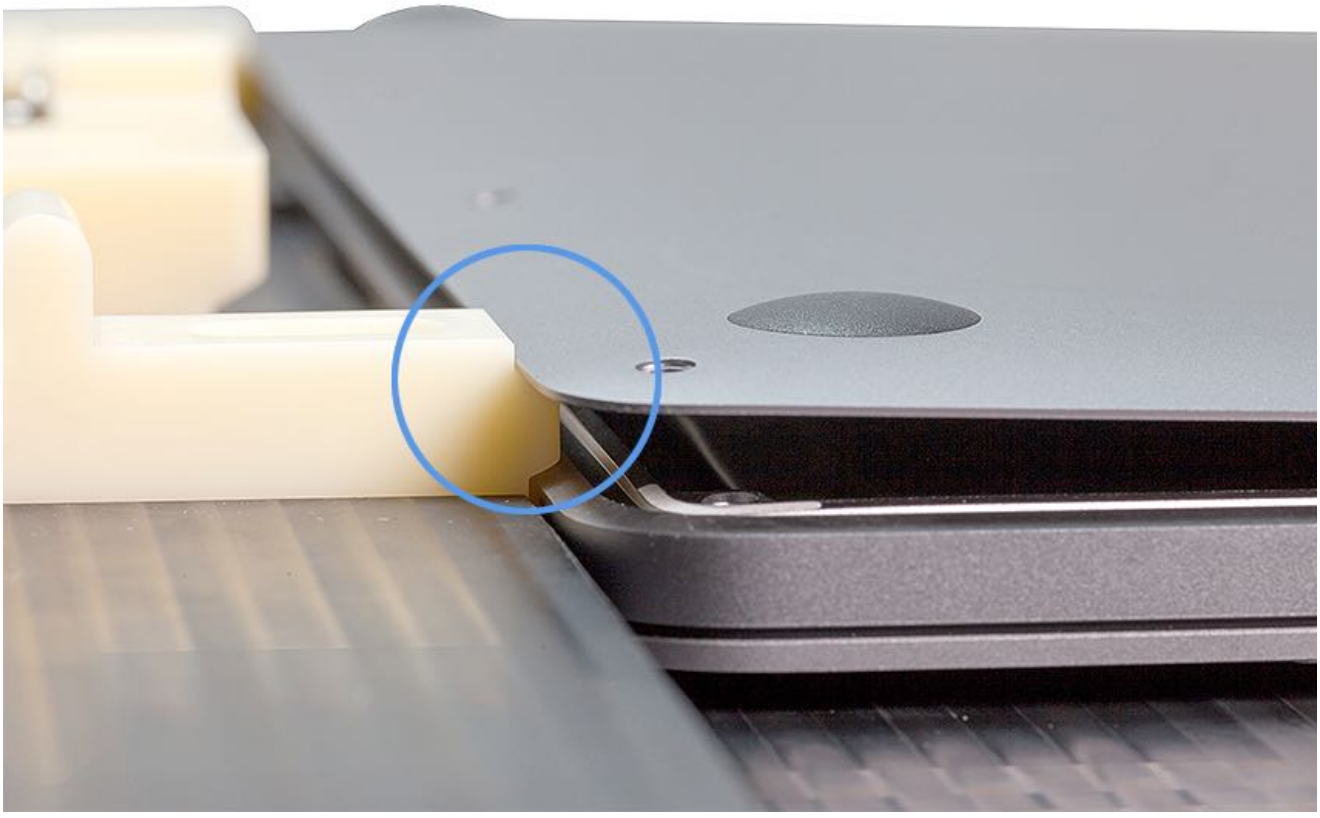
- Retain the original bottom case until the repair is complete. Write the system serial number on the inside of the replacement bottom case. You might need a magnifying glass to read it.



2. Reconnect the battery cable. Then place the computer on the bottom case fixture, making sure the back edge is away from you.
3. Engage the four sliding locks— *not* the two rollers.
4. Remove the battery cover.

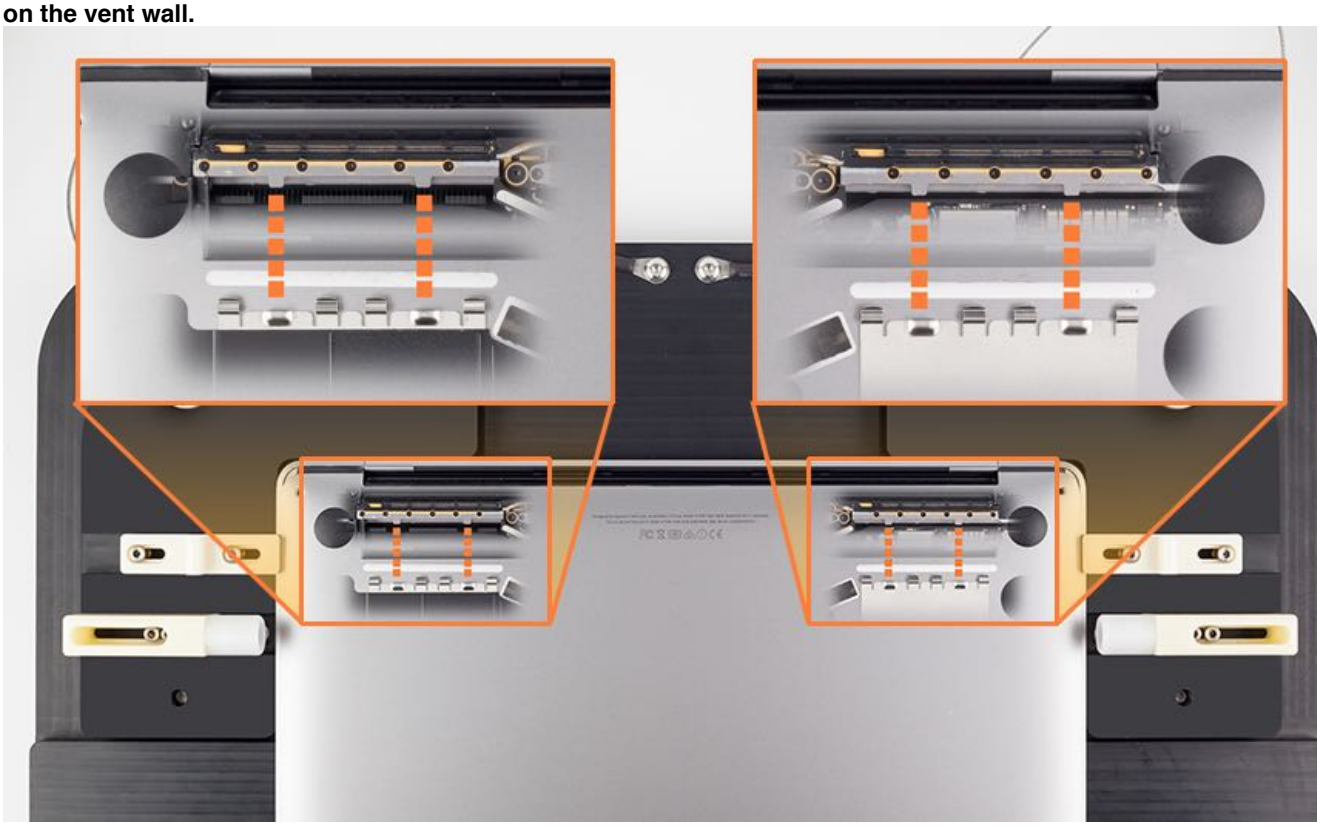


5. Position the bottom case so that its front edge rests on the “shelf” of the lower two sliding locks.

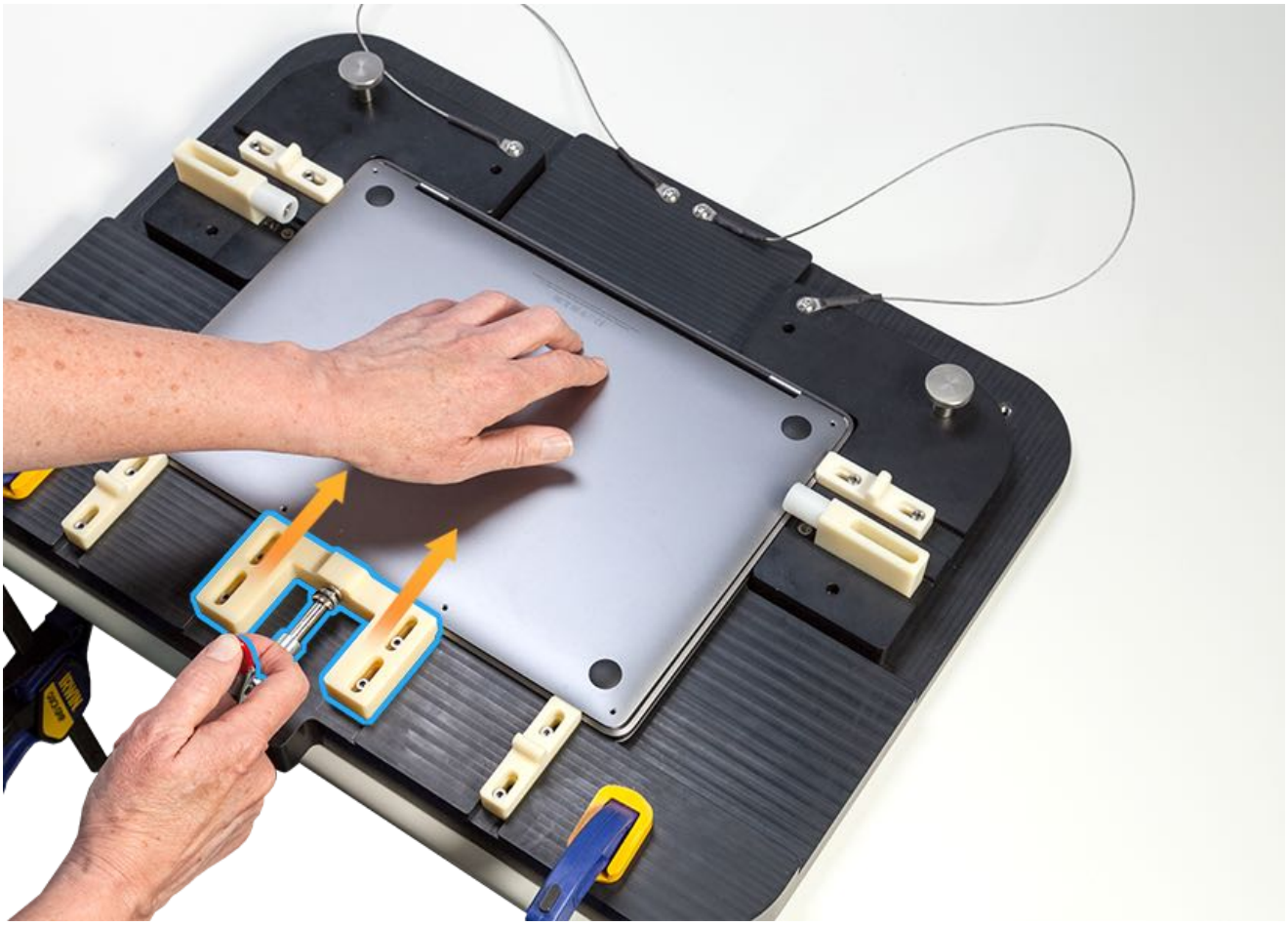


6. Align the back of the bottom case to the vent/antenna module. The alignment is correct when you can feel that the long edge of the bottom case is flush with the smooth plane of the vent/antenna module.

Important: When set up correctly, the notches at each rear corner show an equal gap. **Likewise, if the bottom case were transparent, the two rows of spring fingers inside the bottom case would start to align with the metal tabs on the vent wall.**

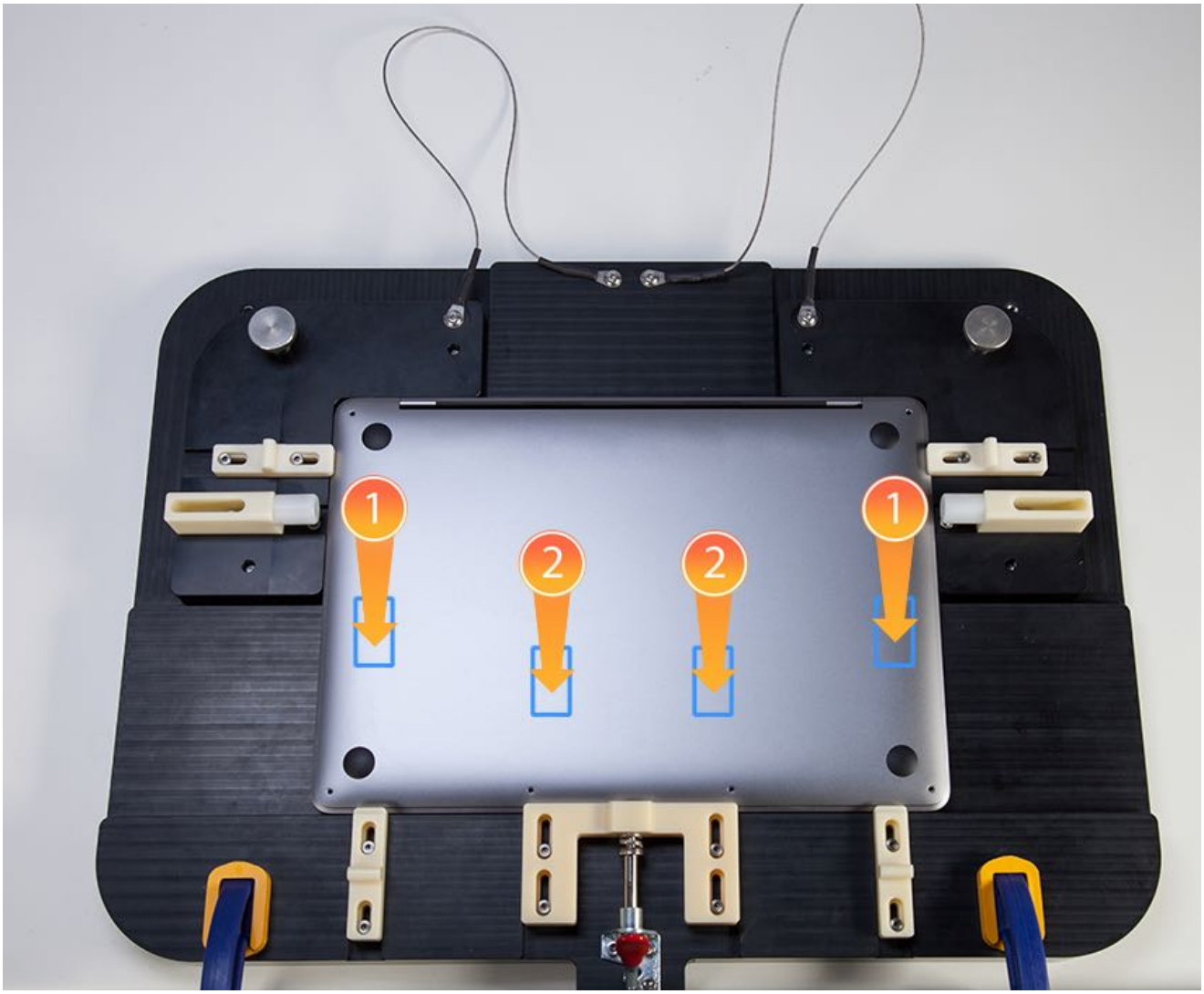


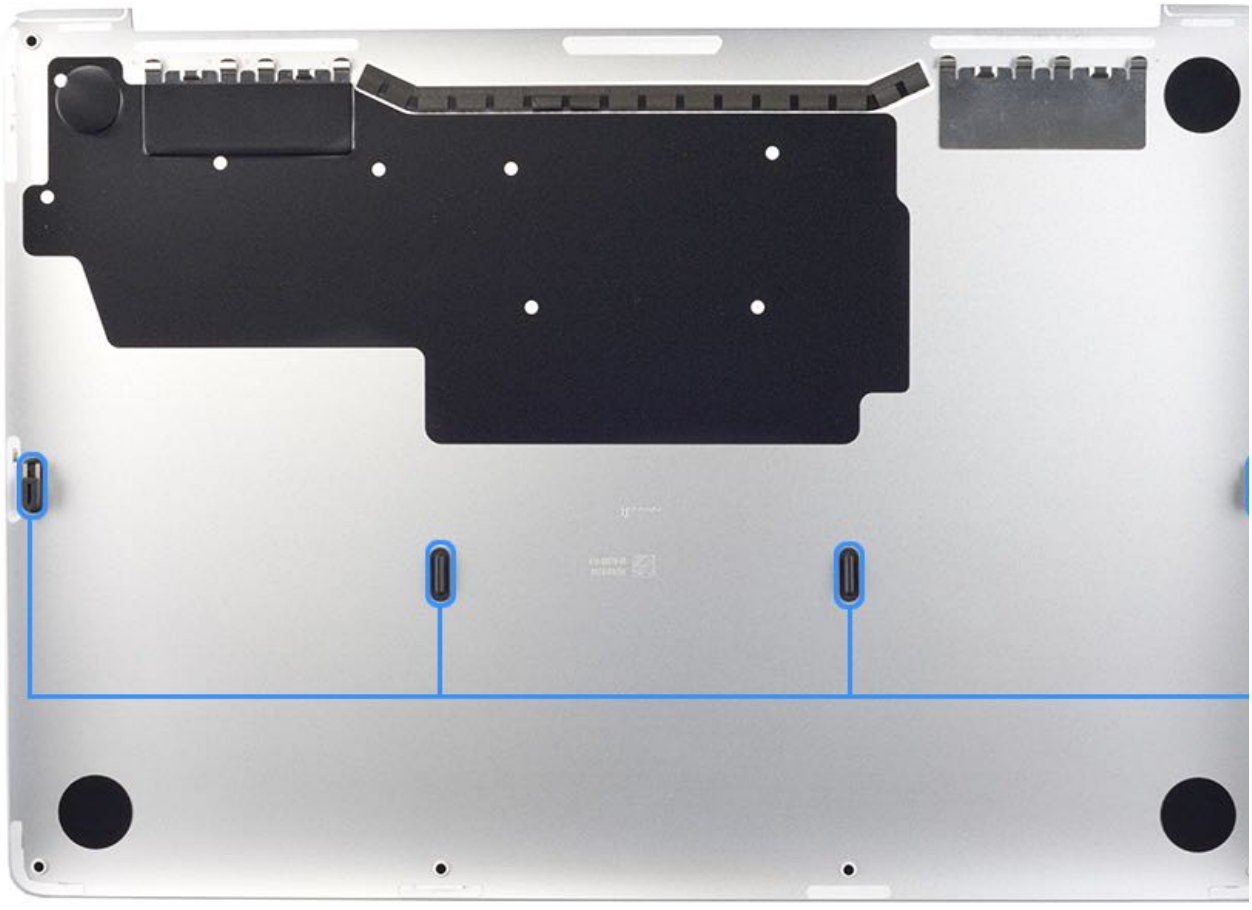
7. Hold light pressure near the back center edge of the bottom case while slowly engaging the red lever. Feel the spring fingers engage slightly as you press down on the bottom case.
   Caution: Pushing the red lever all the way can distort the bottom case and the lever spring.



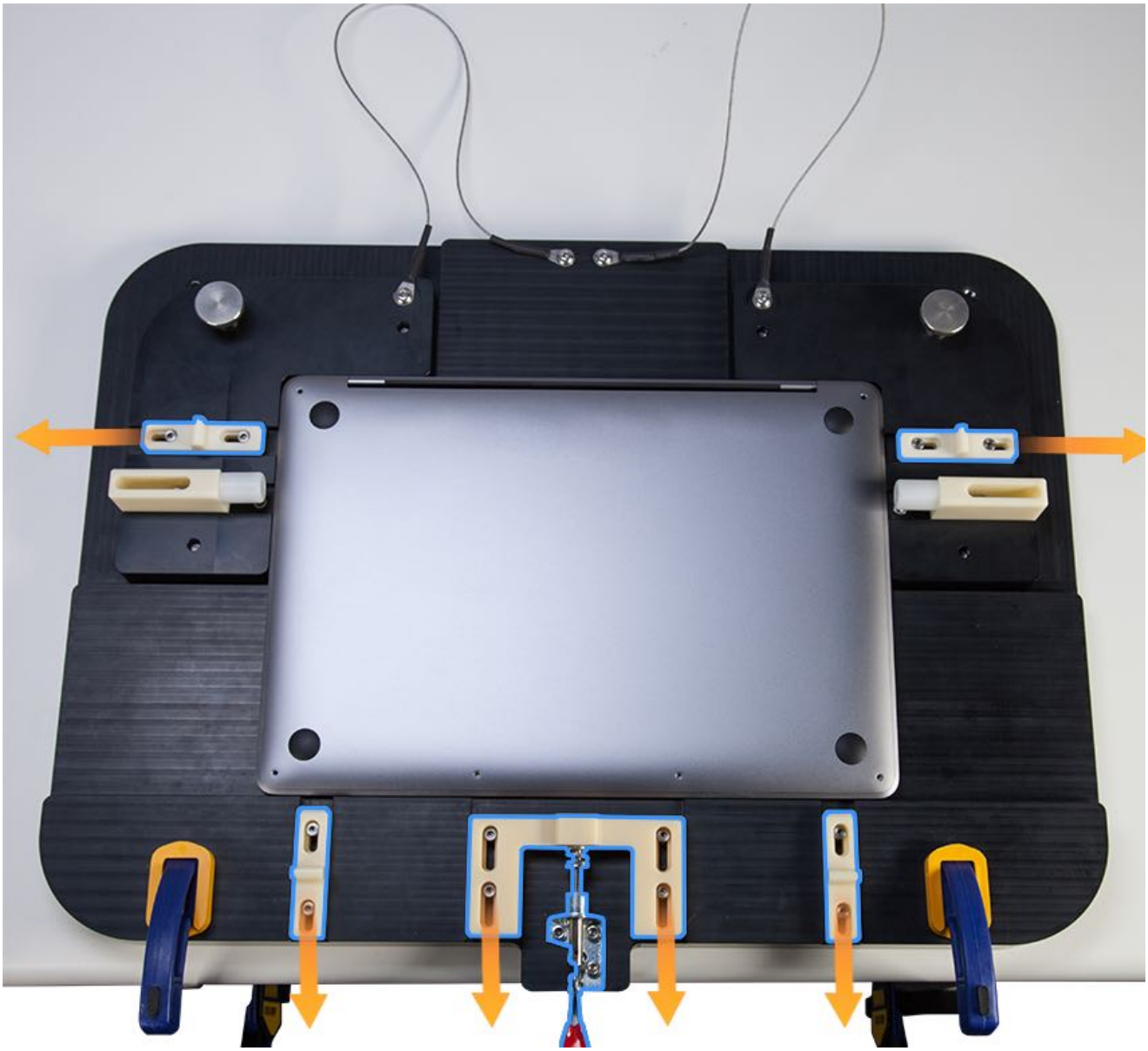
8. As soon as the rear corners of the bottom case meet the top case corners, disengage the lever.
9. If the bottom case is slightly misaligned, use the gripping texture of the gloves to gently apply pressure to adjust the case into alignment. If applying pressure does not realign the bottom case, remove the bottom case and try again.

10. **Important:** Press the sides (1) of the bottom case first to snap the two clips in the top case. Then press in the middle (2) of the bottom case for the two remaining clips.

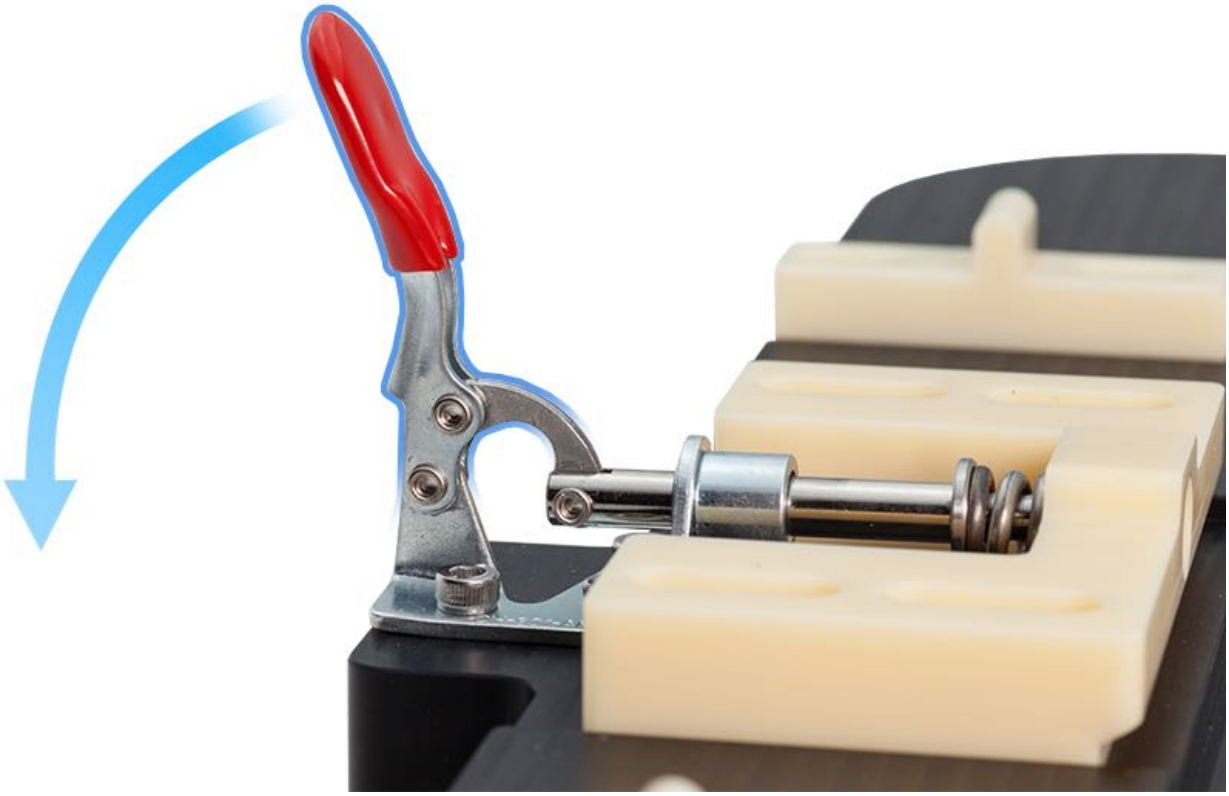




11. Fully disengage the four (4) sliding locks.

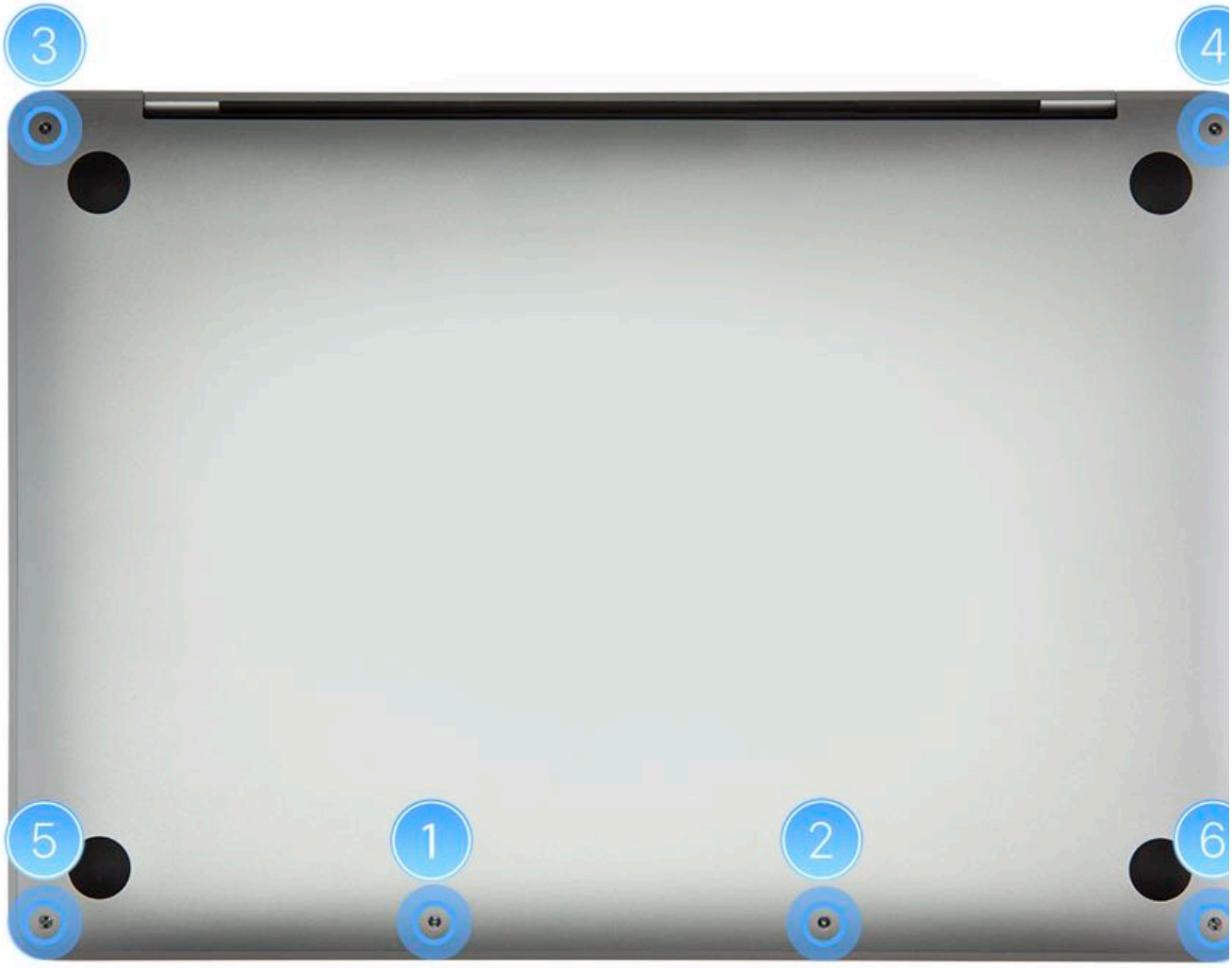


12. Remove the computer from the bottom case fixture.
Note: When storing the bottom case fixture, make sure that the red lever is not engaged. Keeping the red lever vertical or fully open protects its inner spring.



13. Check all sides of the bottom case for proper alignment with the top case.

14. Install the six bottom case screws in the order shown:
    1, 2 = short screws at middle front
    3, 4 = longest screws at rear corners
    5, 6 = medium length screws at front corners
    Note: MacBook Pro (13-inch, 2016 and 2017, Four Thunderbolt 3 Ports) and MacBook Pro (15-inch, 2016 and 2017) only have two sizes of screws but reinstallation order is the same.



15. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
16. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Battery Cover and Disconnecting the Battery

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

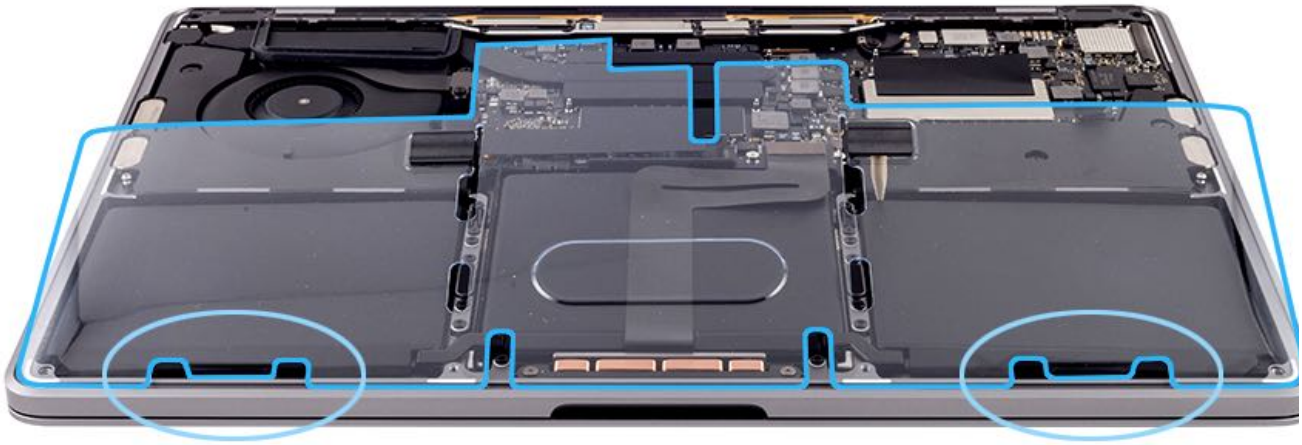
- Bottom case

Tools

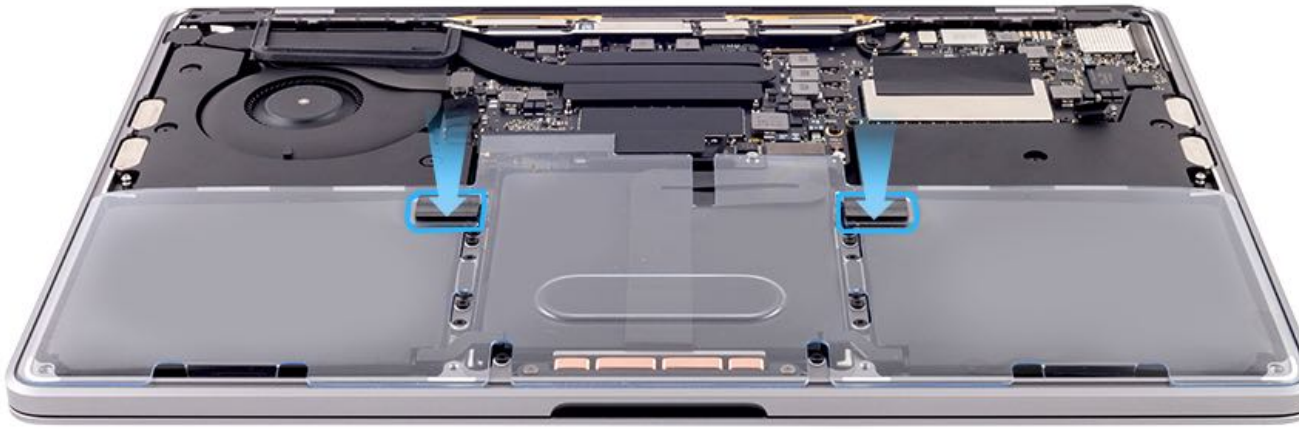
- ESD wrist strap
- Black stick
- Tweezers
- Battery cover (923-01318)

Steps For Removal

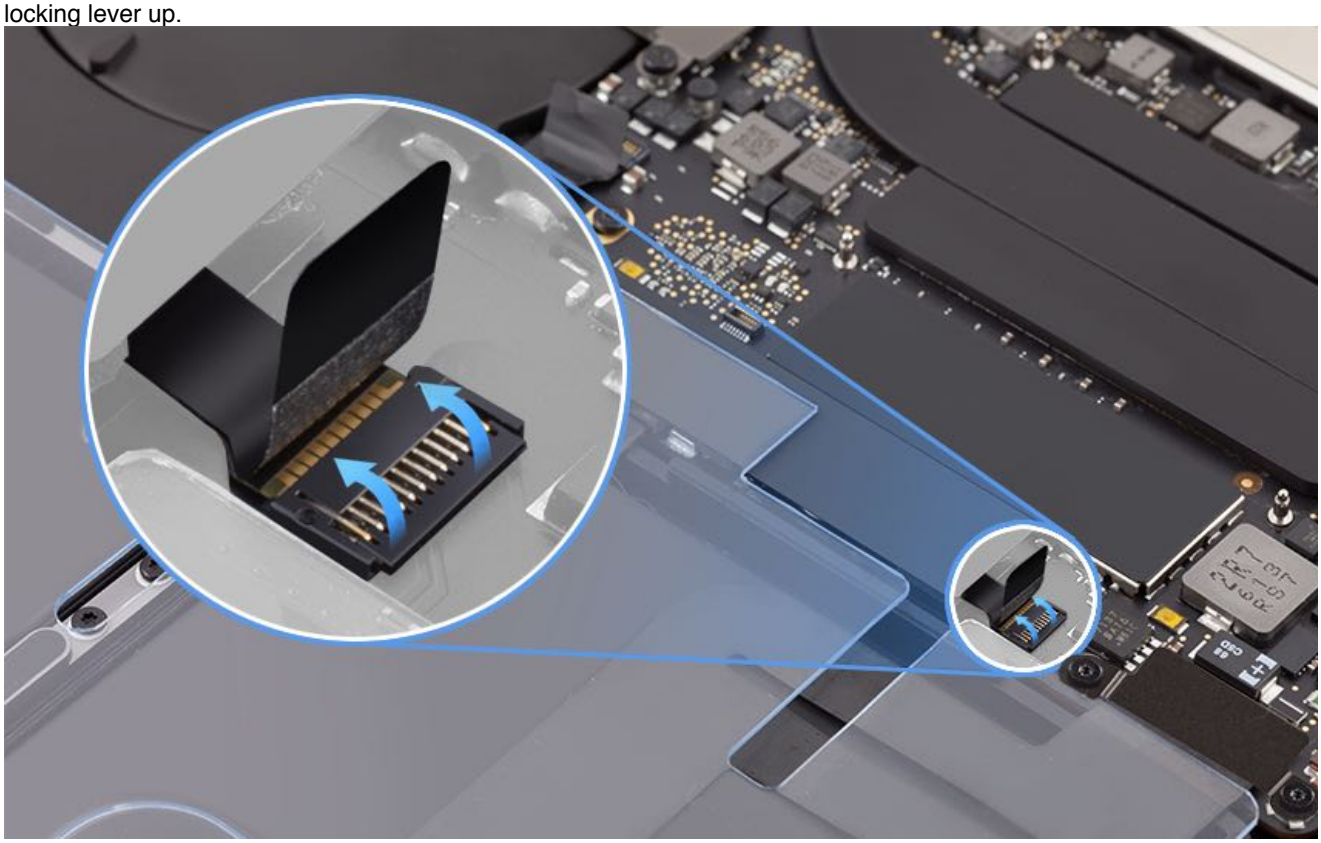
1. Tilt the battery cover so the front edge of the battery cover slips underneath the front lip of the top case.



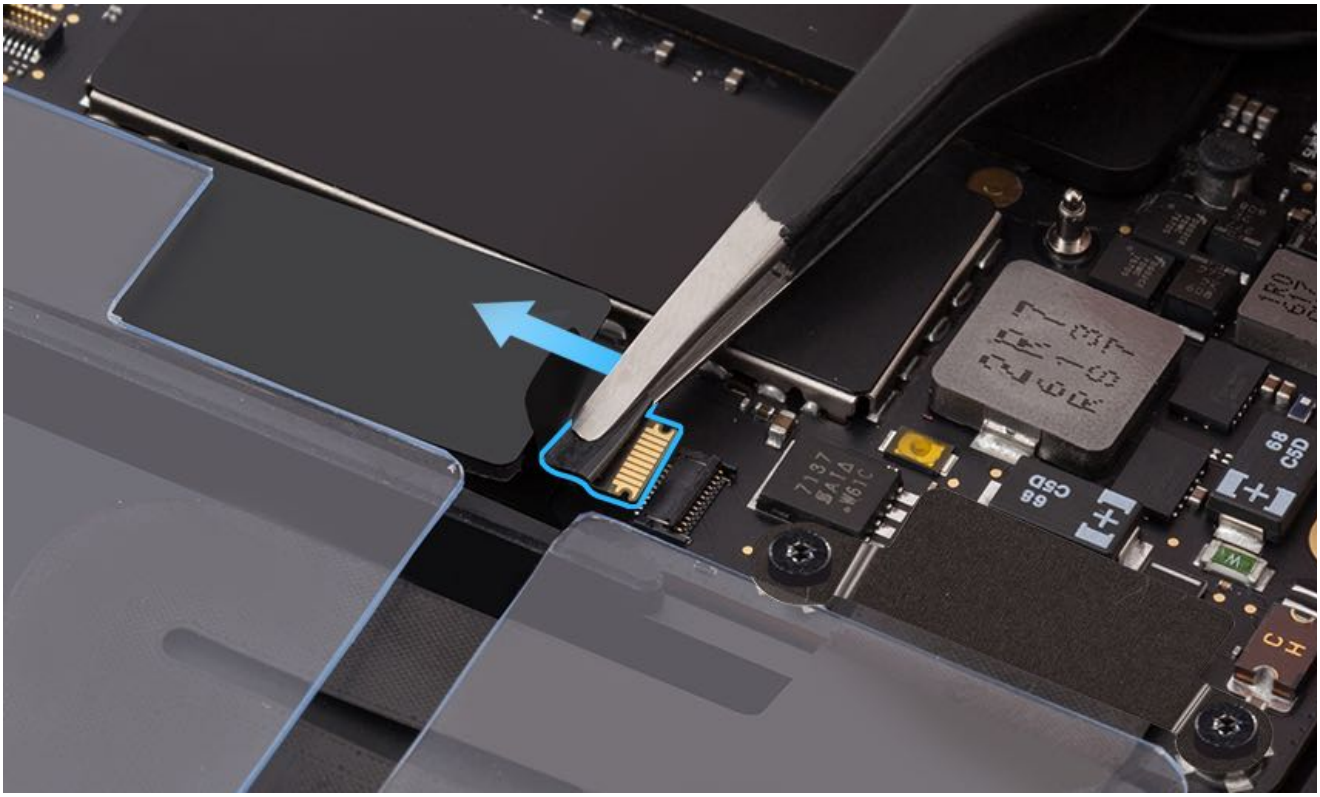
2. Securely attach the battery cover with two (2) clips that snap onto the midwall of the top case.



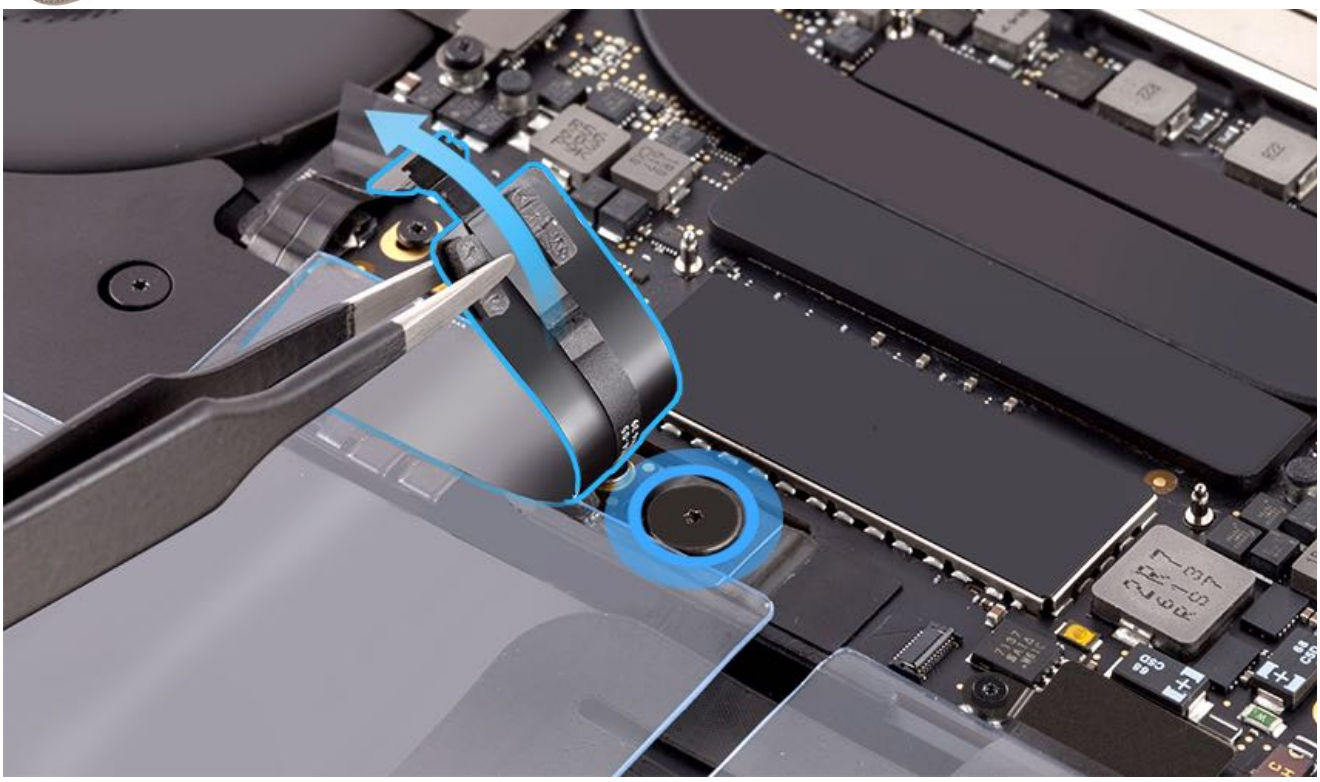
3. Pull back the battery flex cable tab to expose the battery flex cable connector. Use the flat end of a black stick to flip the locking lever up.



4. Gently disconnect the battery flex cable from the connector on the logic board.



5. **If removing the logic board, fan, or top case:** Peel back the Battery Management Unit (BMU) Mylar cover on the BMU board to access the BMU power screw. Remove the T5 BMU screw (923-01189).



Steps For Reassembly

1. Reinstall the T5 BMU screw (if the logic board, fan, or top case were removed).
2. Reconnect the battery flex cable.
3. Remove the battery cover.
4. Reinstall the bottom case.
5. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
6. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Battery Management Unit (BMU) Mylar Cover

First Steps

Warning:

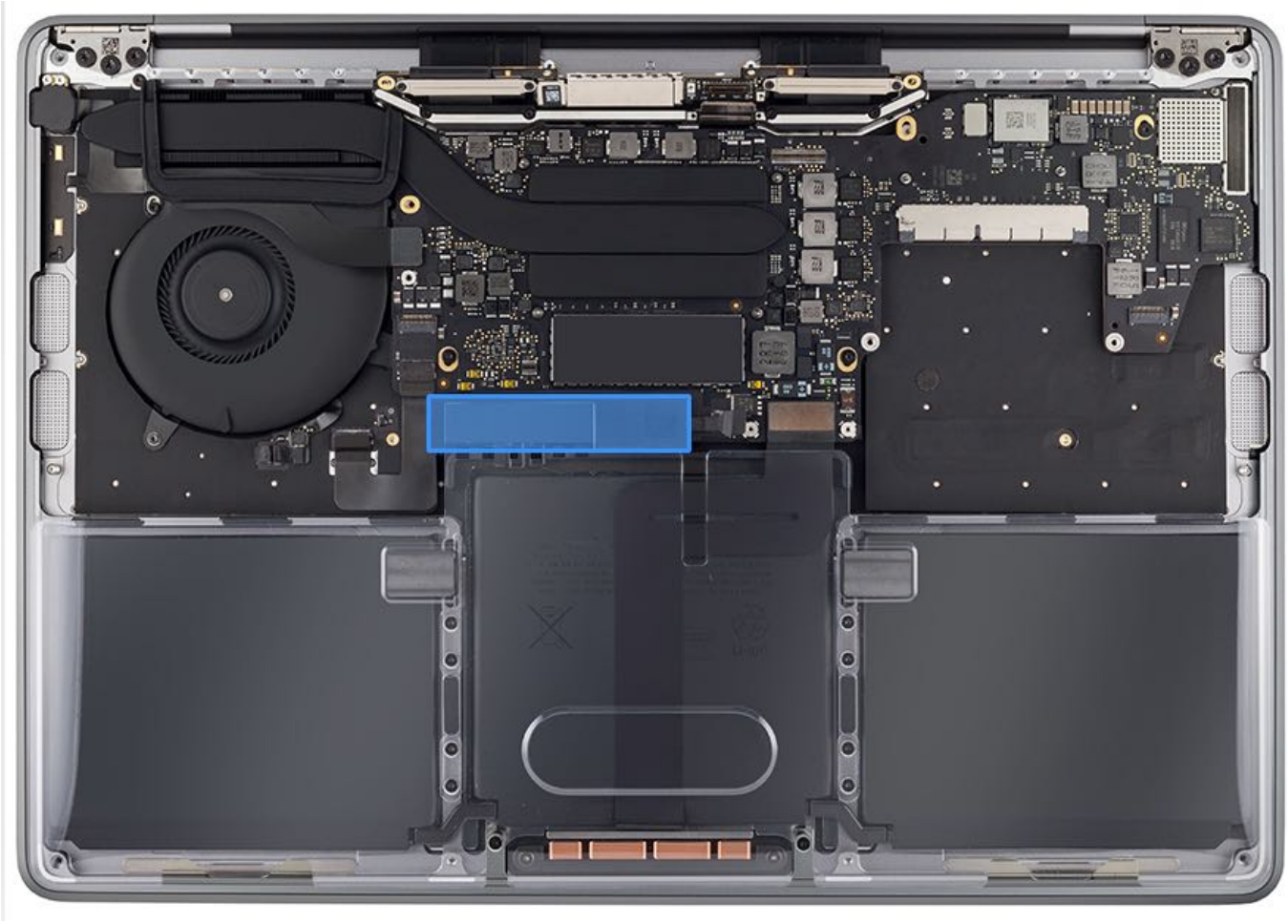
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case



Tools

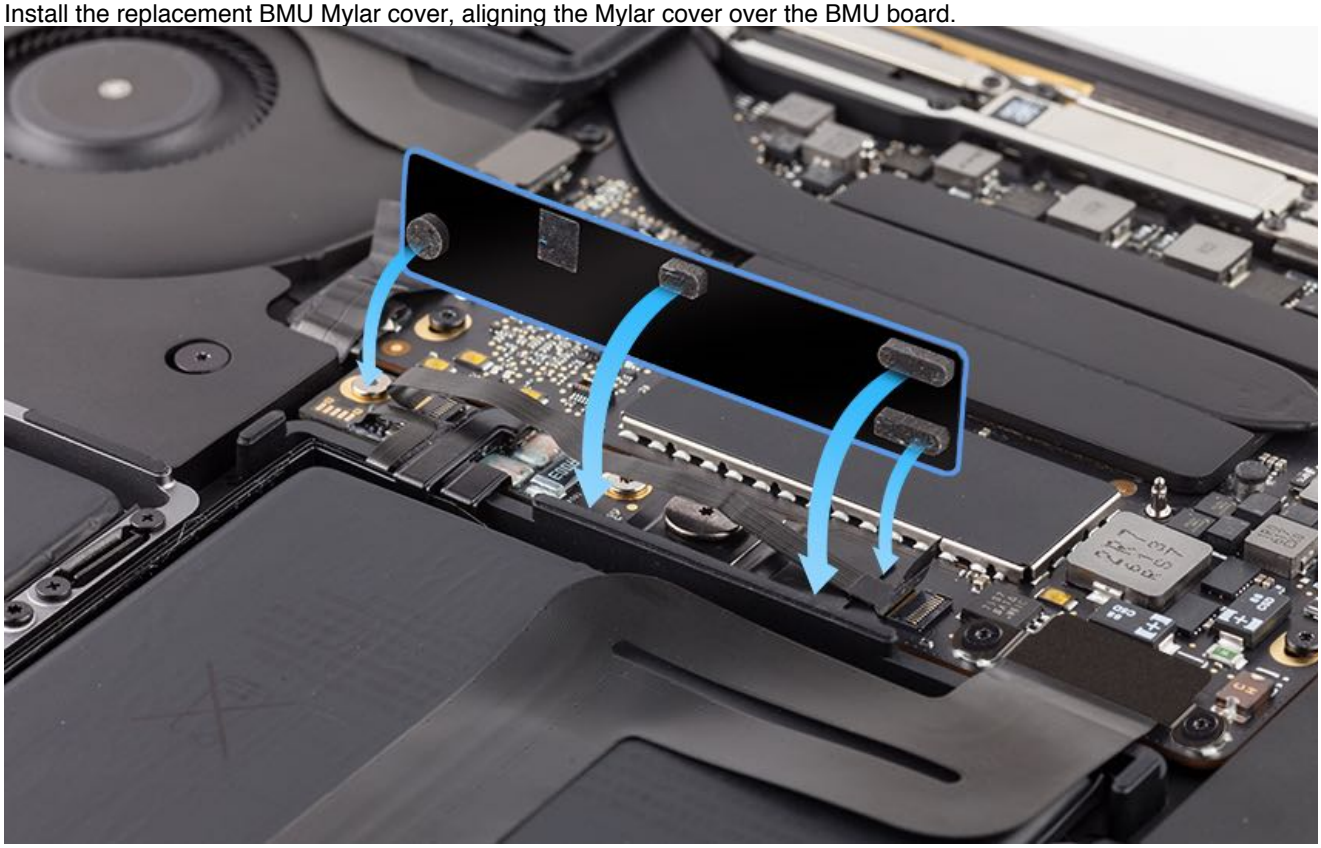
- ESD wrist strap
- Black stick

Steps For Removal

1. Disconnect one side of the BMU flex cable.
2. Using your fingers, gently peel the BMU Mylar cover off the BMU board.

Steps For Reassembly

1. Remove any residual foam and/or adhesive present on the BMU board before installing a replacement BMU Mylar cover.
2. Remove the adhesive backers from the replacement BMU Mylar cover.
3. Install the replacement BMU Mylar cover, aligning the Mylar cover over the BMU board.



4. Reconnect the BMU flex cable to the logic board and press the locking lever flat.
5. Reinstall the bottom case.
6. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
7. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Battery Management Unit (BMU) Flex Cable

First Steps

Warning:

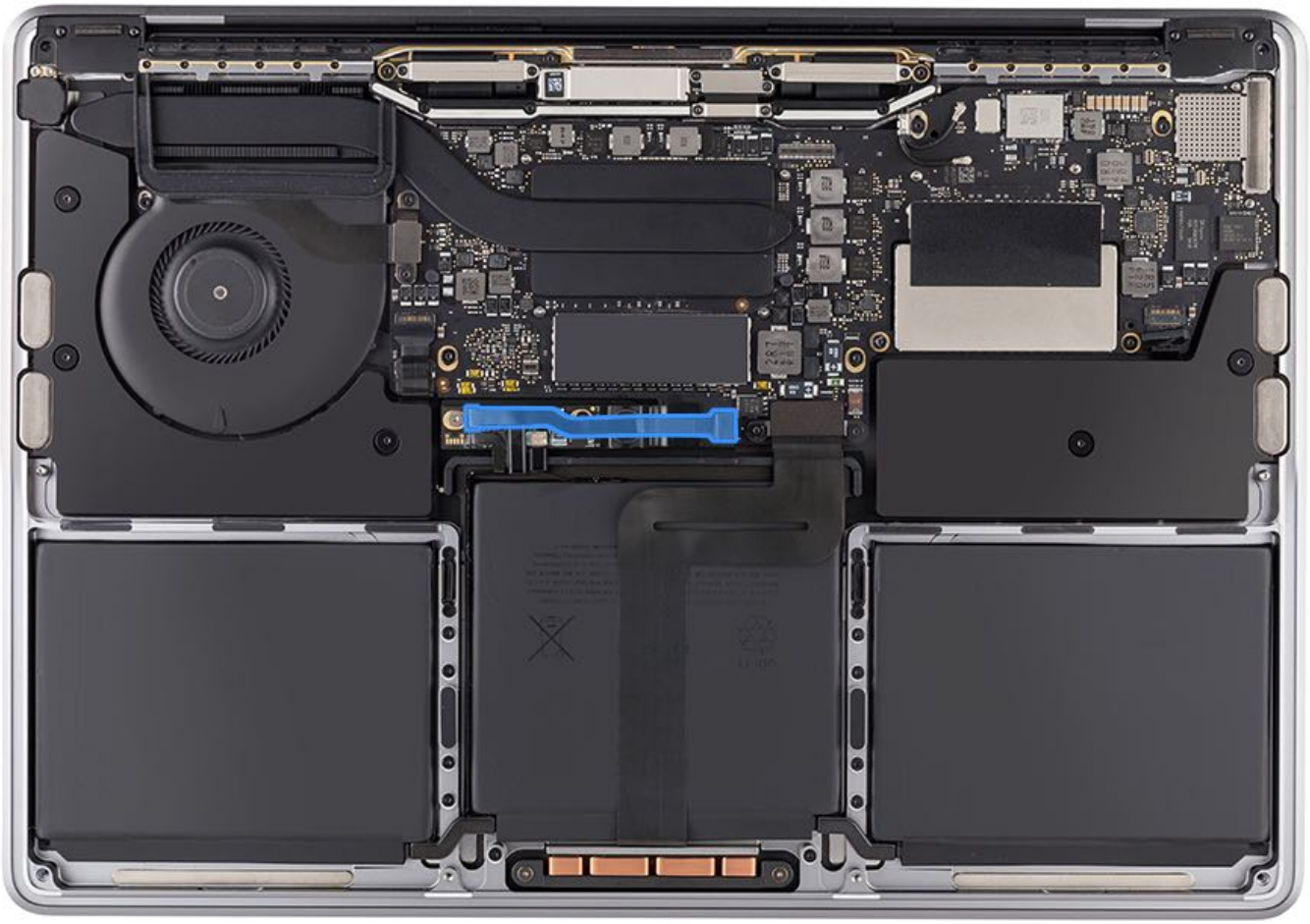
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case

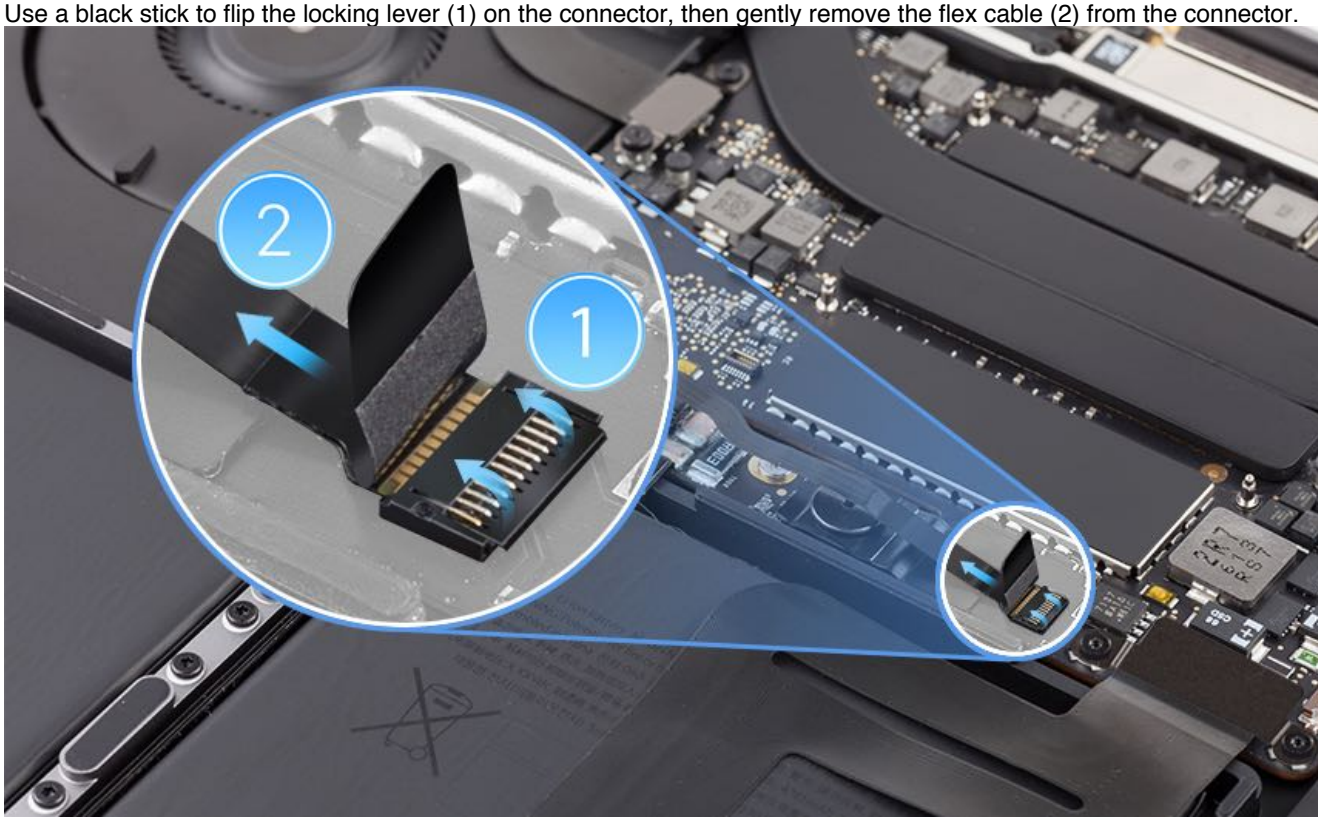


Tools

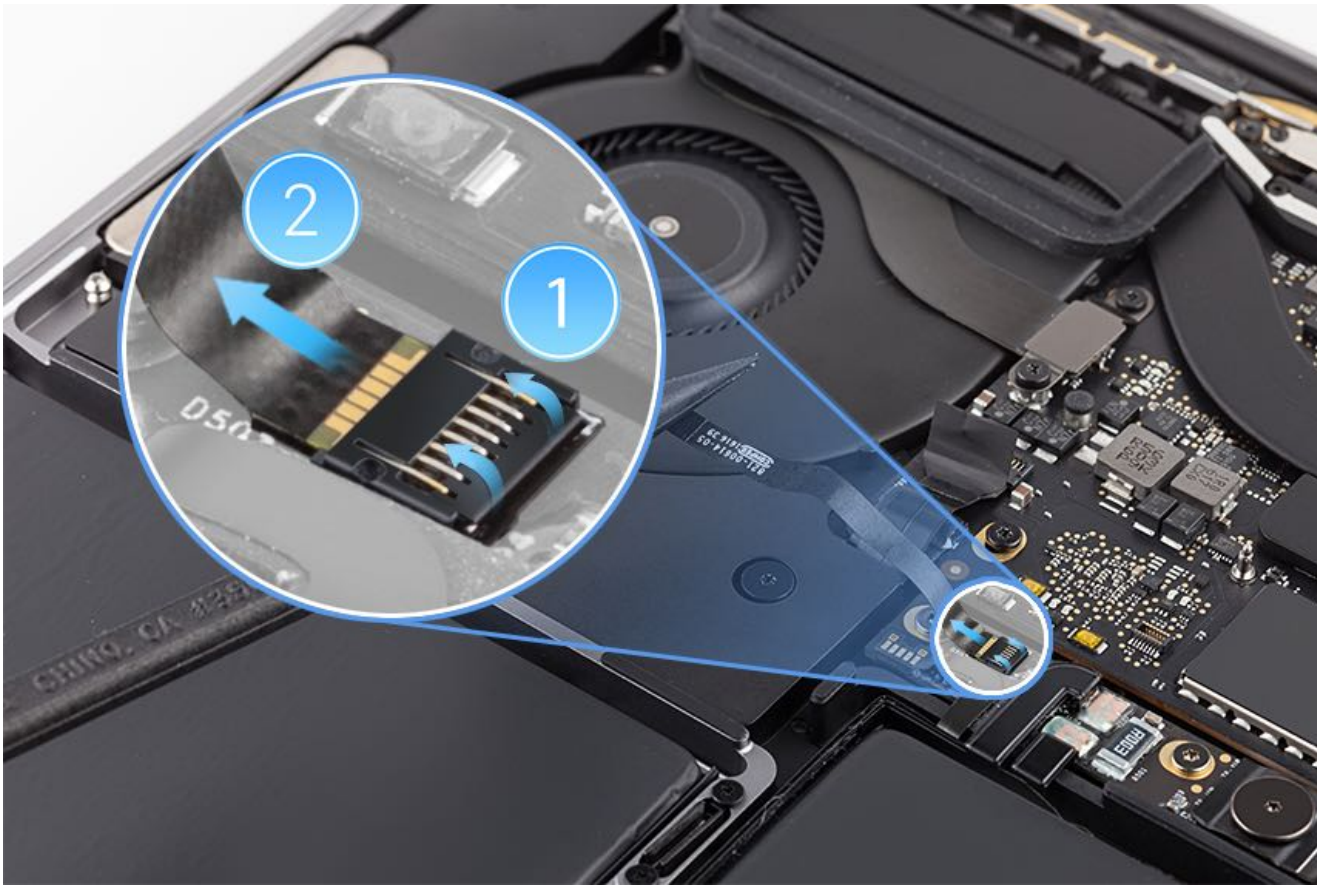
- ESD wrist strap
- Black stick

Steps For Removal

1. Use a black stick to flip the locking lever (1) on the connector, then gently remove the flex cable (2) from the connector.



2. Use a black stick to flip the locking lever (1) on the other end of the BMU connector, then gently remove the flex cable (2) from the connector.



Steps For Reassembly

1. Reinstall the BMU flex cable and press the locking levers flat.
2. Install a new BMU Mylar cover.
3. Reinstall the bottom case.
4. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
5. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Speakers

First Steps

Warning:

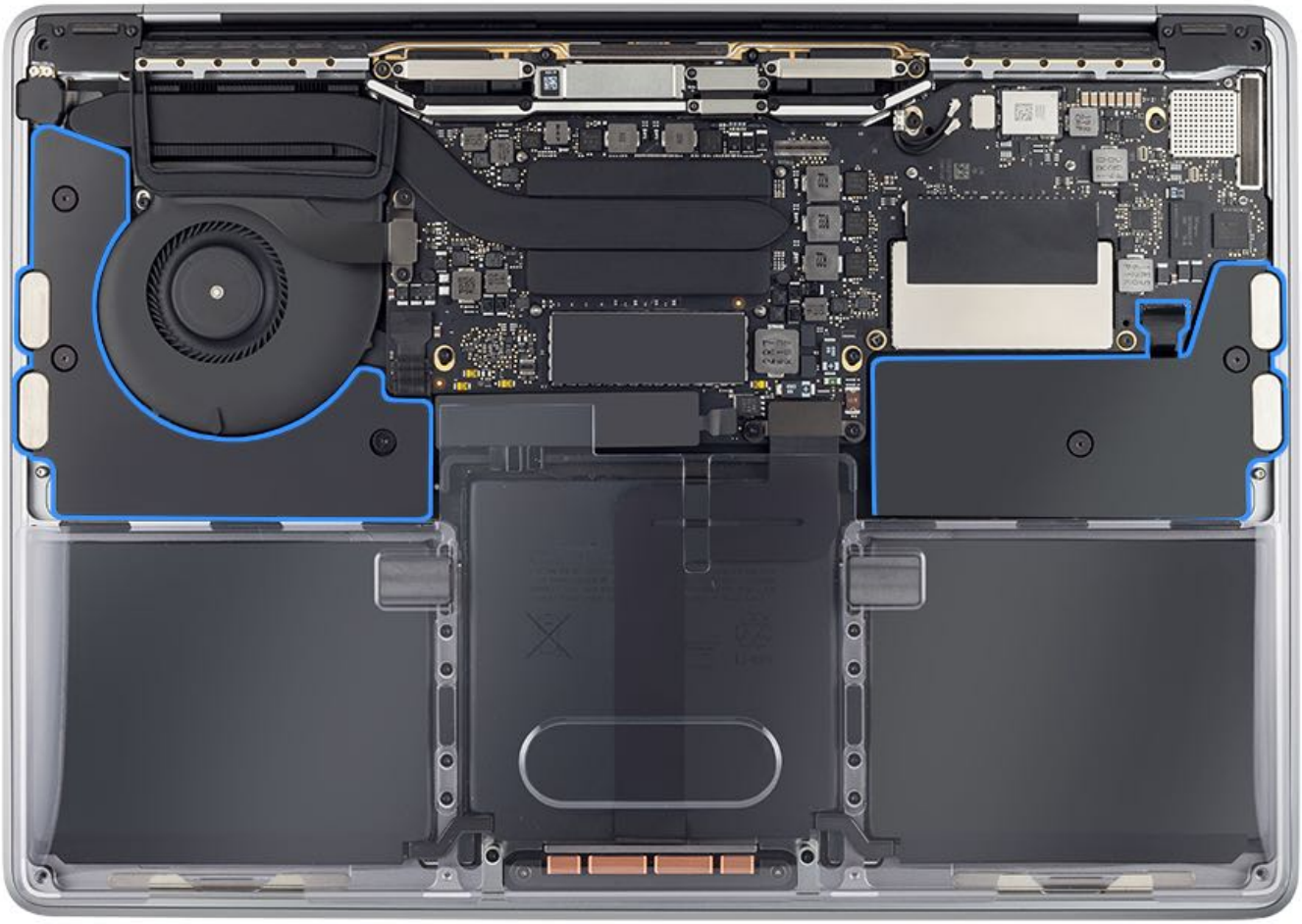
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery



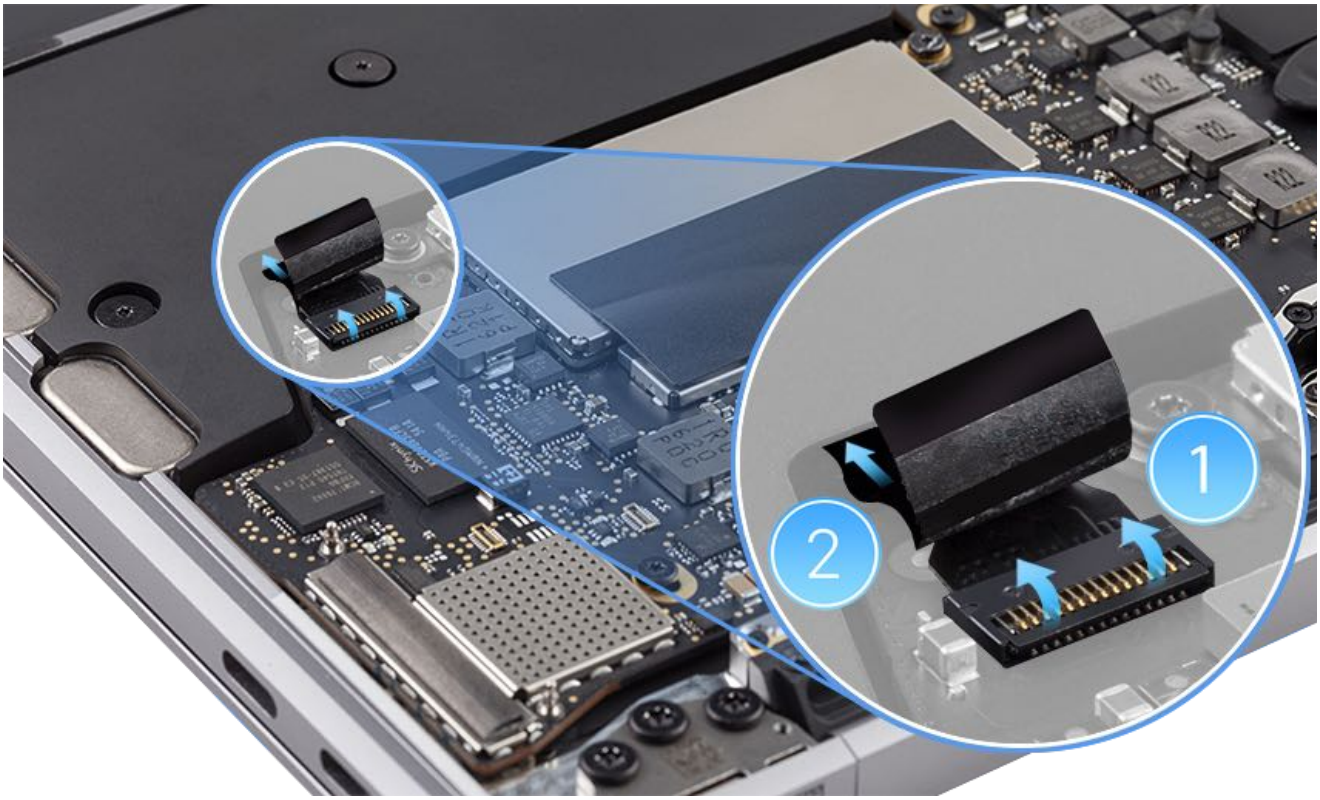
Tools

- ESD wrist strap
- Black stick
- Tweezers
- Torx T5 screwdriver (magnetized)
- Battery cover (923-01318)

Steps For Removal

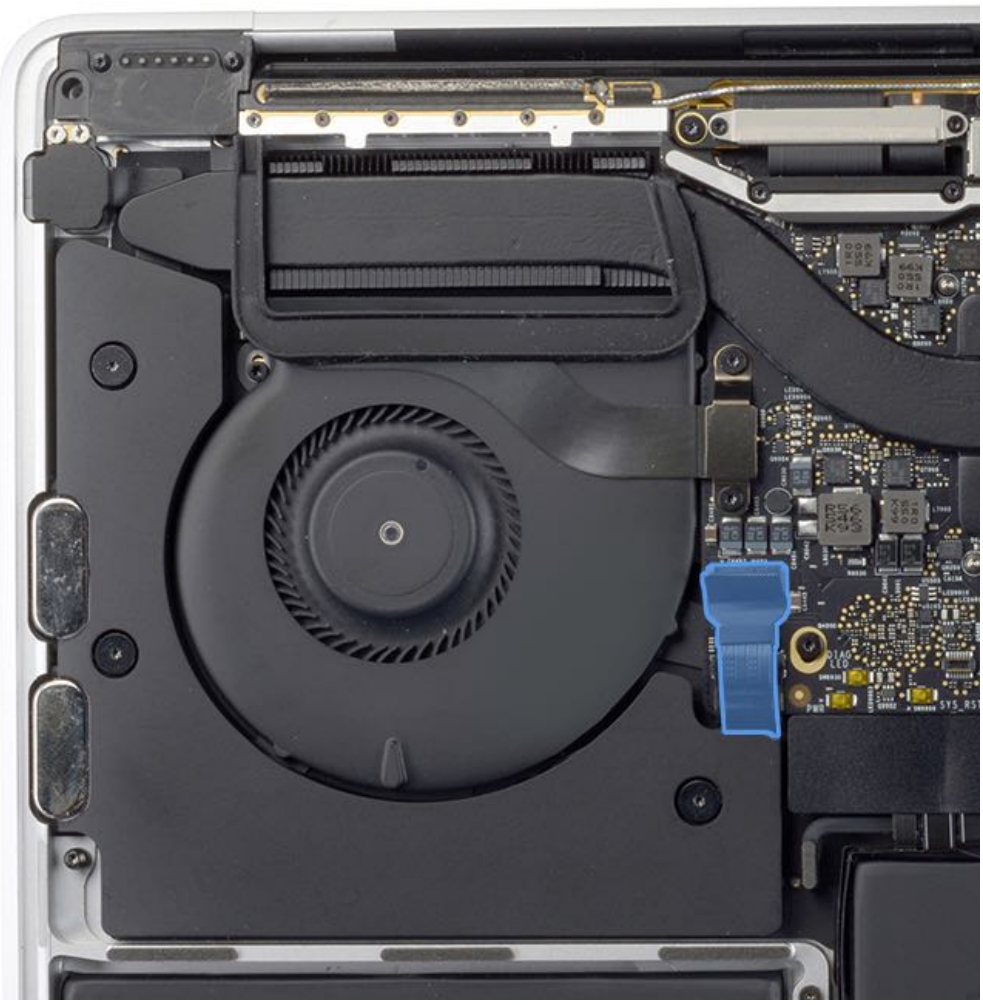
1. Locate the left speaker flex cable connector. Gently peel back the Mylar tab on the flex cable to expose the connector.

2. Rotate the computer clockwise to view the flex connector from the angle shown below. Use the flat end of a black stick to flip the locking lever (1), then gently remove the flex cable (2) from the connector on the logic board.

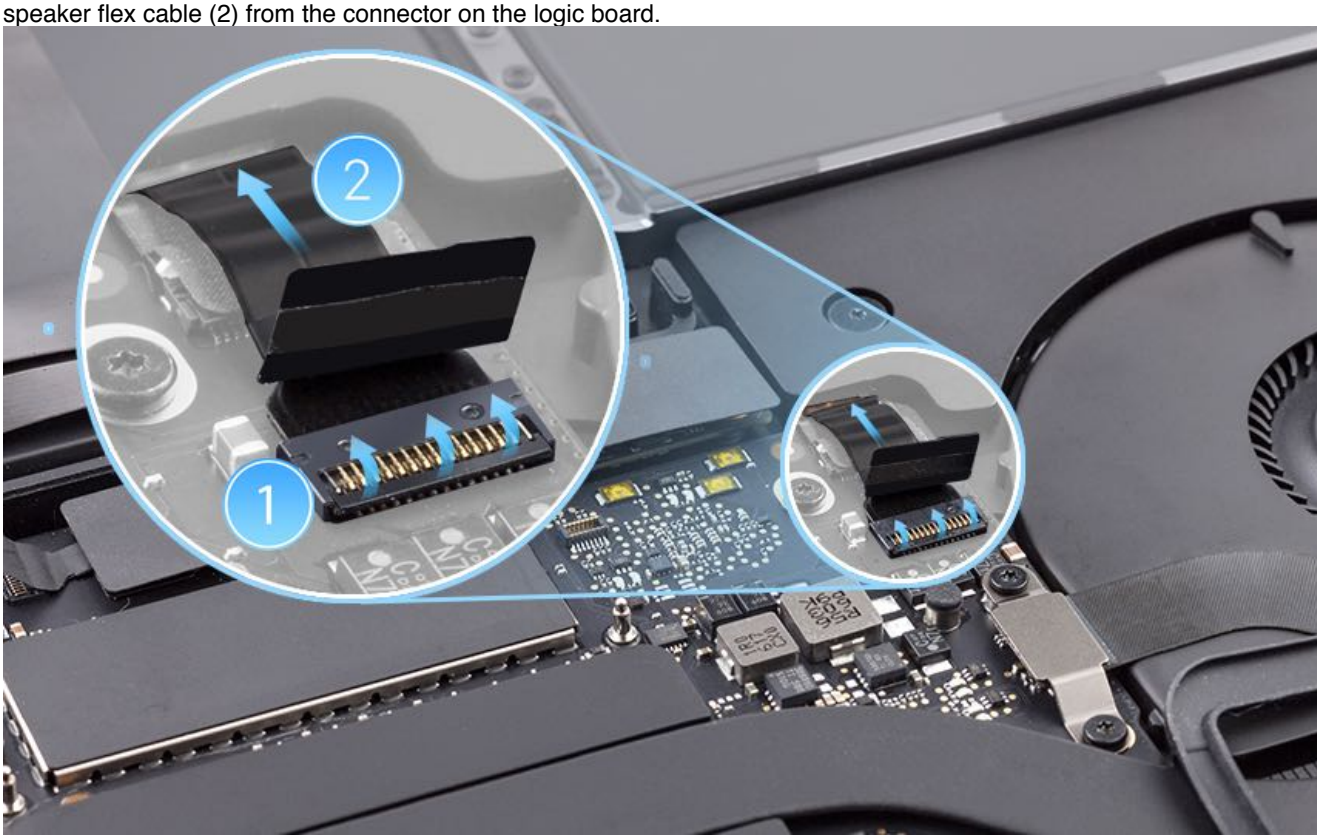


3. Rotate the computer counter clockwise, so the display hinge is at the top. Remove two T5 screws (923-01178) and gently lift the left speaker from the top case.

4. Locate the right speaker flex cable connector. Gently peel back the Mylar tab on the flex cable to expose the connector.



5. Rotate the computer 90 degrees clockwise to view the speaker flex connector from the angle shown below. **Note:** The keyboard flex cable is underneath the speaker flex cable. Be careful not to damage the keyboard flex cable when removing the speaker flex cable. Use the flat end of a black stick to flip the locking lever (1), then gently remove the speaker flex cable (2) from the connector on the logic board.

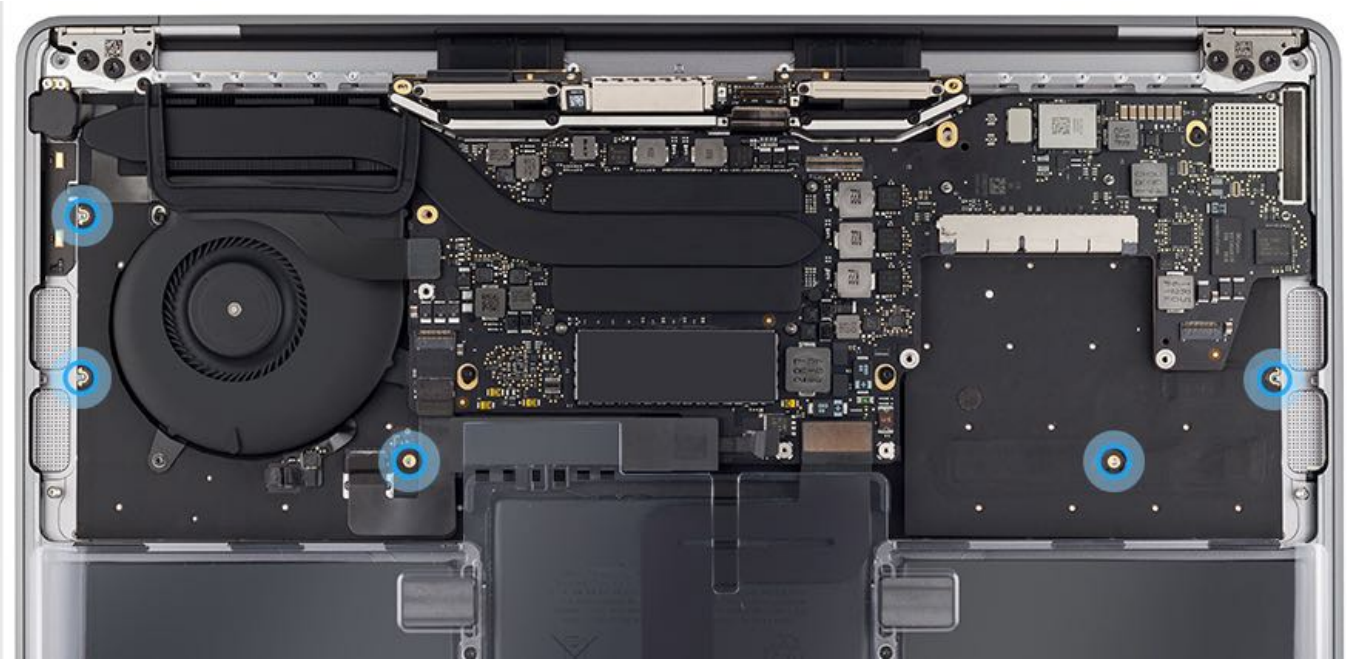


6. Remove three T5 screws and gently lift the right speaker from the top case. **Note:** The longer screw is on the lower right side, near the speaker flex cable.

923-01178

Steps For Reassembly

Important:
When replacing a speaker: Inspect the top case for the speaker screw standoffs.



if the standoff is missing from the top case, inspect the speaker screw. If the silver standoff came off with the speaker screw (as shown below), separate the standoff from the screw with a plier and a torx driver.

- Inspect the speaker standoff for any damage. If there's no standoff damage and the blue strip of Nylok® is still intact, then reinstall the standoff in the top case before installing the speaker.
- Inspect speaker screw for any damage and make sure the blue strip of Nylok® is intact before installing screw.

If damaged, then acquire appropriate screw pack:

- 923-01302, Speaker standoff, pack of 5
- 923-01178, Speaker screw, long, pack of 5
- 923-01179, Speaker screw, short, pack of 5

When transferring a speaker to a new top case:
A new top case comes with the speaker standoffs mounted. If the speaker standoff is still attached to the sccrew, separate the screw and speaker standoff, inspect the screw for any damage and dispose of the standoff. Check that the blue strip of Nylok® is intact. Reuse the screw if there's no apparent damage, or order applicable speaker screws if needed.

1. Reinstall the speakers in the top case (see Important notes above).
2. Reconnect the speaker flex cables, secure the locking levers on each connector, and press the connector lever flat.
3. Reinstall five T5 speaker screws.
4. Reconnect the battery flex cable to the logic board.
5. Remove the battery cover.
6. Reinstall the bottom case.
7. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
8. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Flash Storage

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

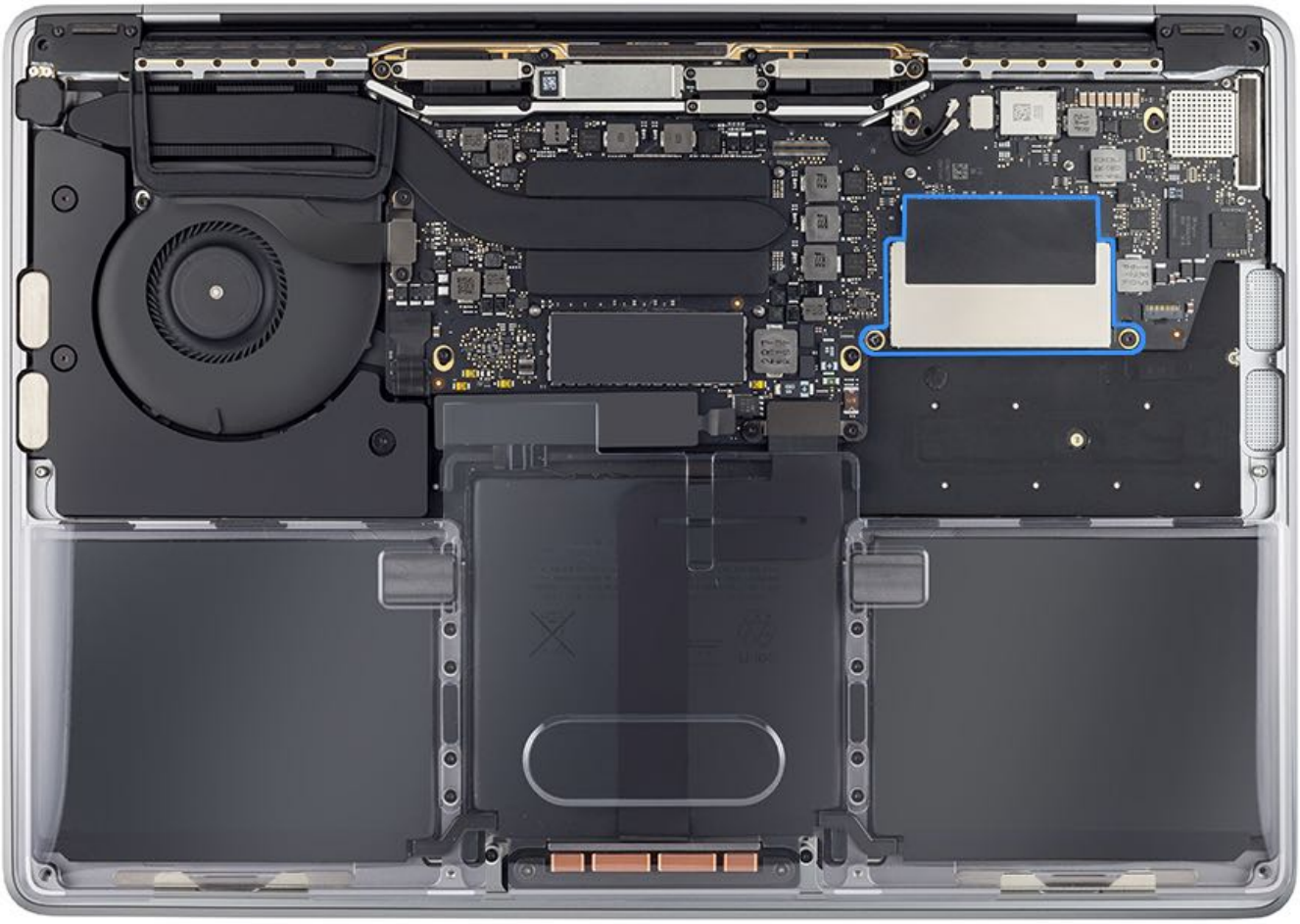
Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.
- Some MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports) Flash Storage must be replaced with a specific model Flash Storage drive. For more information, refer to OP1889: MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports) Flash Storage Service Policy.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Left speaker

For video instruction, refer to article SV307: Flash Storage Replacement Video.



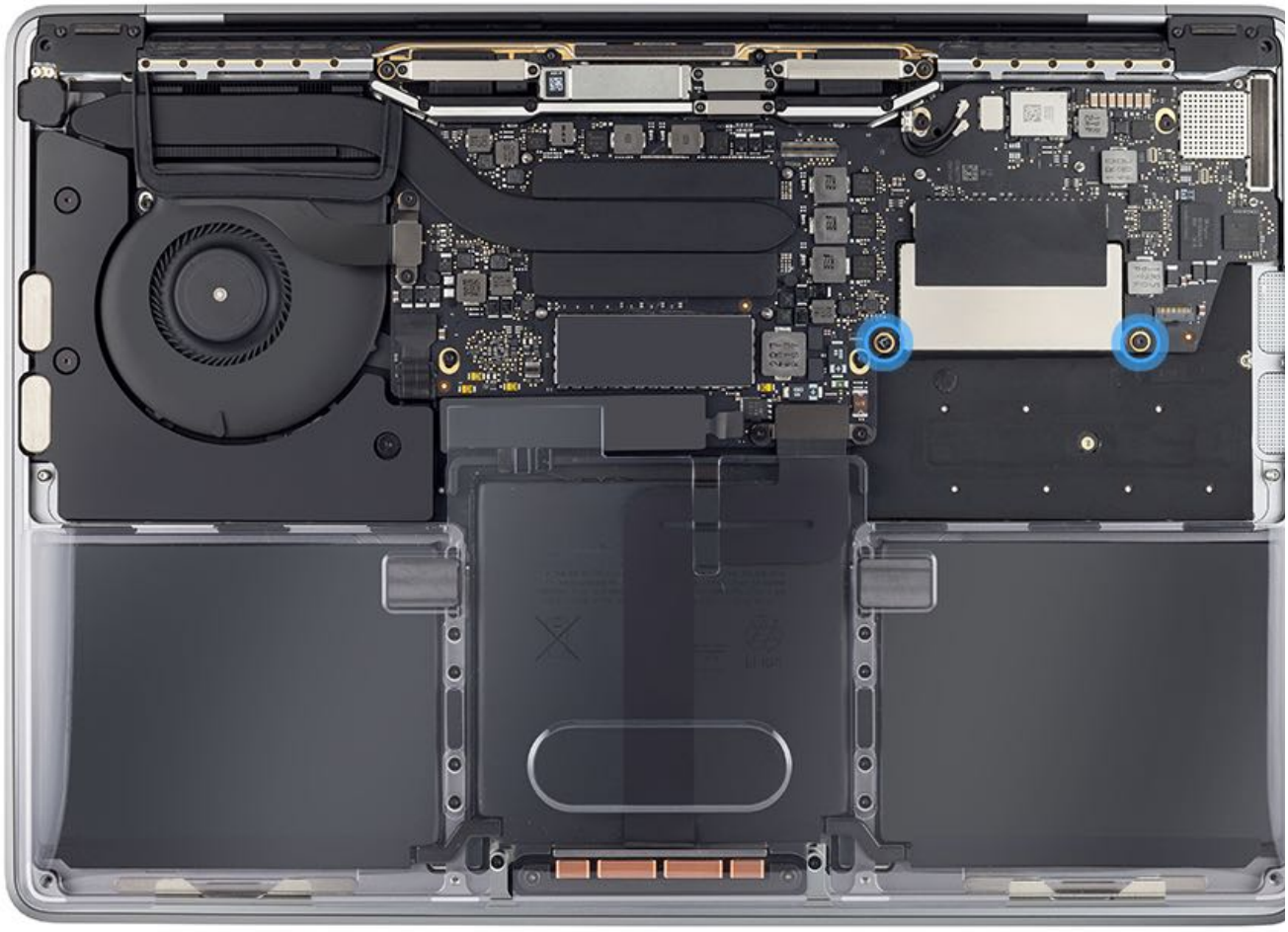
Tools

- ESD strap
- Black stick

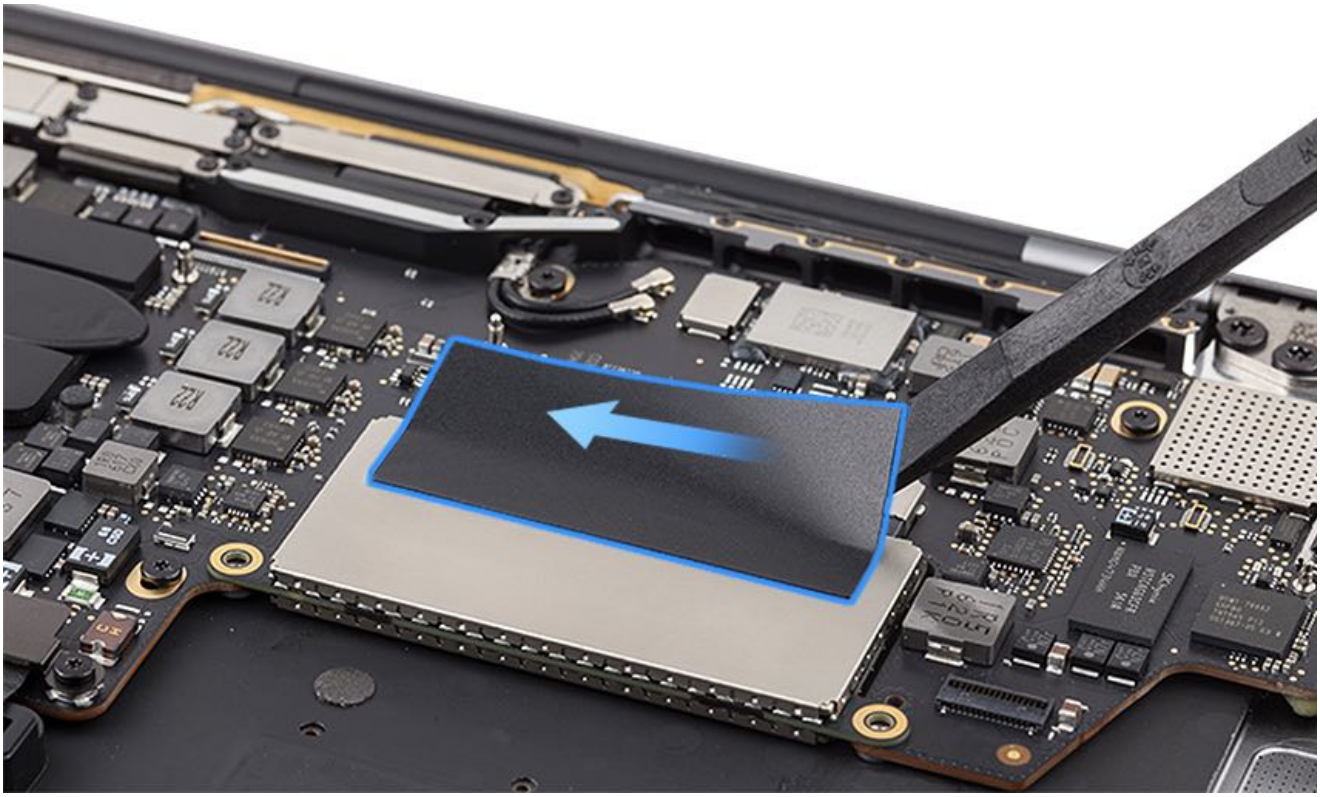
- Torx T5 screwdriver (magnetized)
- Battery cover (923-01318)
- Isopropyl alcohol (IPA) wipes

Steps For Removal

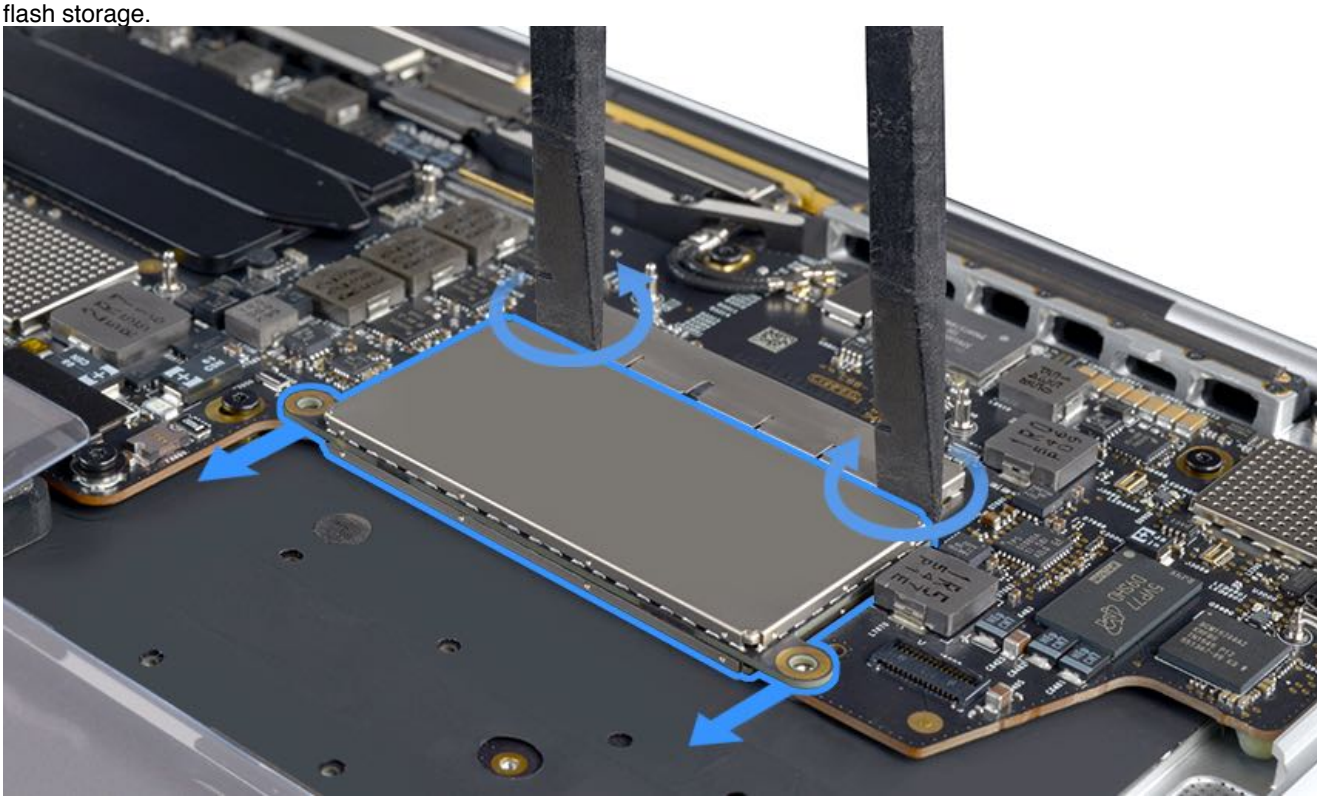
1. Remove two T5 screws (923-01182) from flash storage card.



2. Use the flat end of a black stick to peel the shield tape from the flash storage card connector on the logic board. **Note:** Install a new piece of shield tape every time the flash storage card is removed. Clean any residual adhesive on the flash storage card and connector with an IPA wipe before applying the new shield tape.

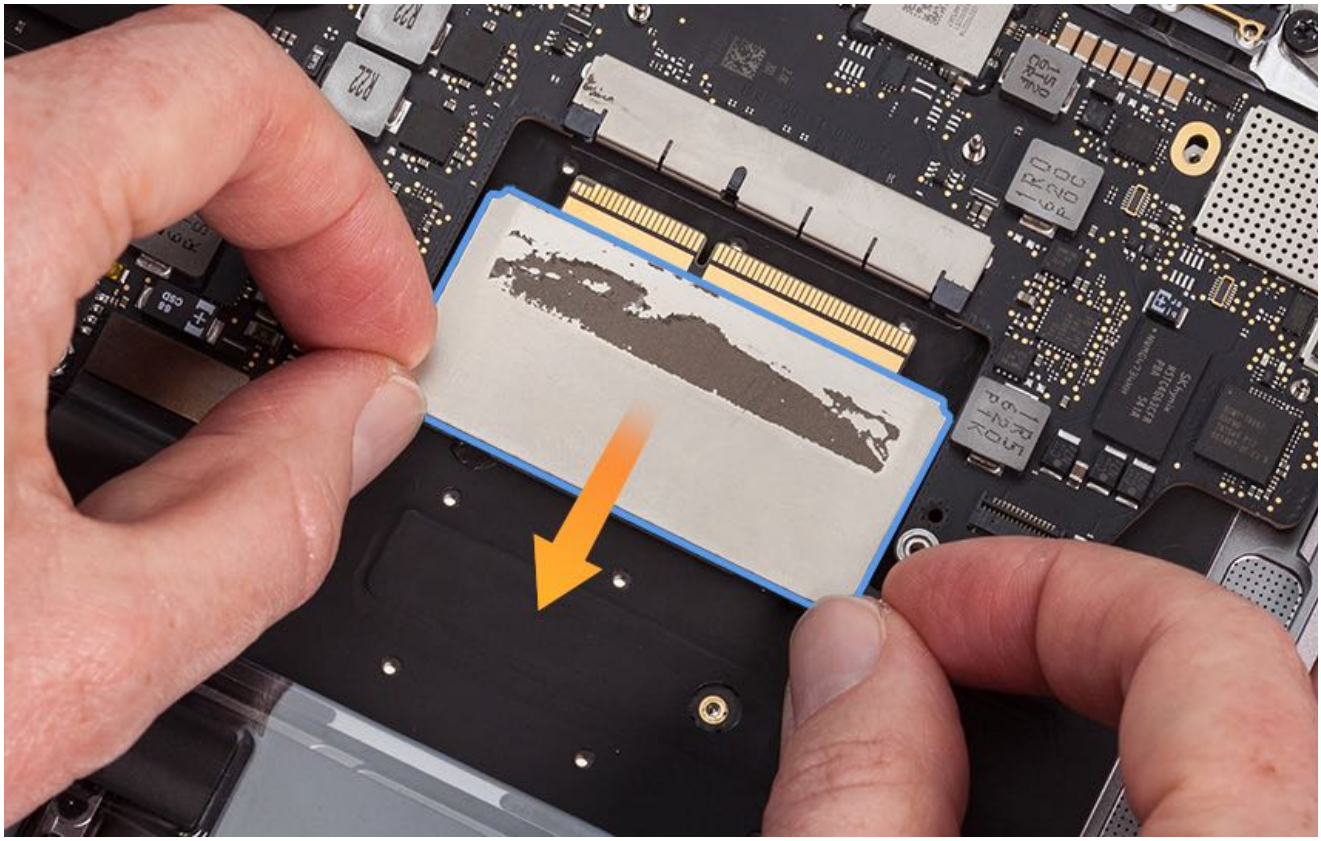


3. Insert the flat end of two black sticks in the top corners between the flash storage card and the connector on the logic board. Simultaneously rotate the left black stick counter-clockwise and the right black stick clockwise to loosen the flash storage.



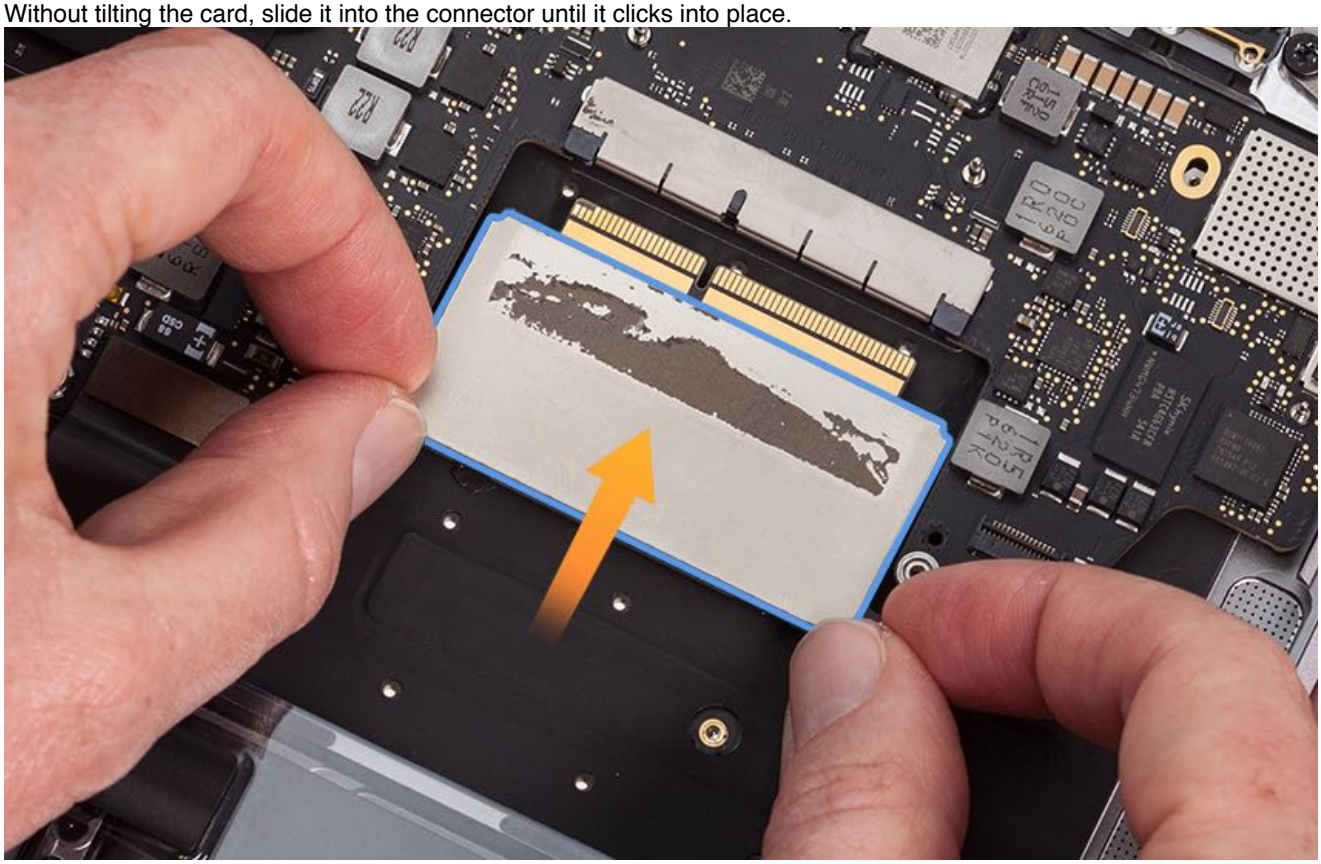
4. When the flash storage card ejects from the connector, gently slide it out.
   Note: Always hold the flash storage card by the edges and avoid the gold contacts.

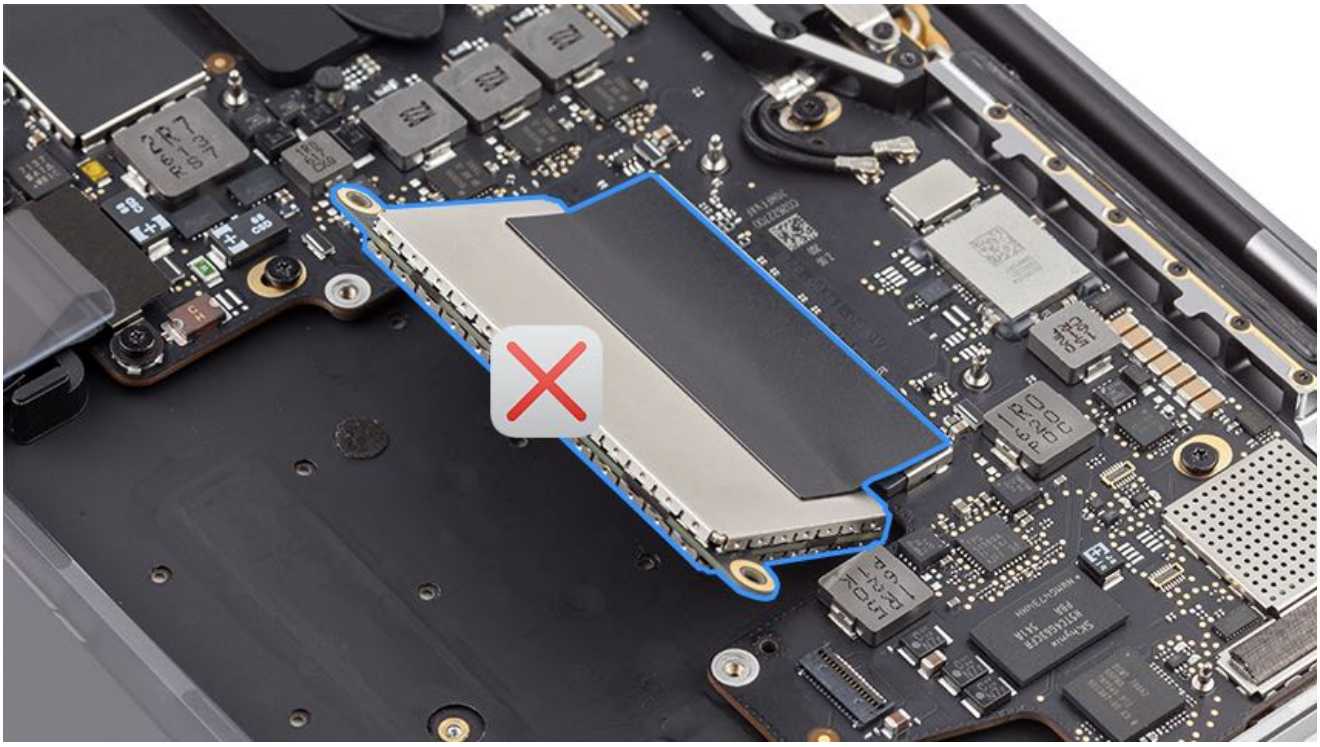
5. Record the flash storage serial number when preparing to return the card.



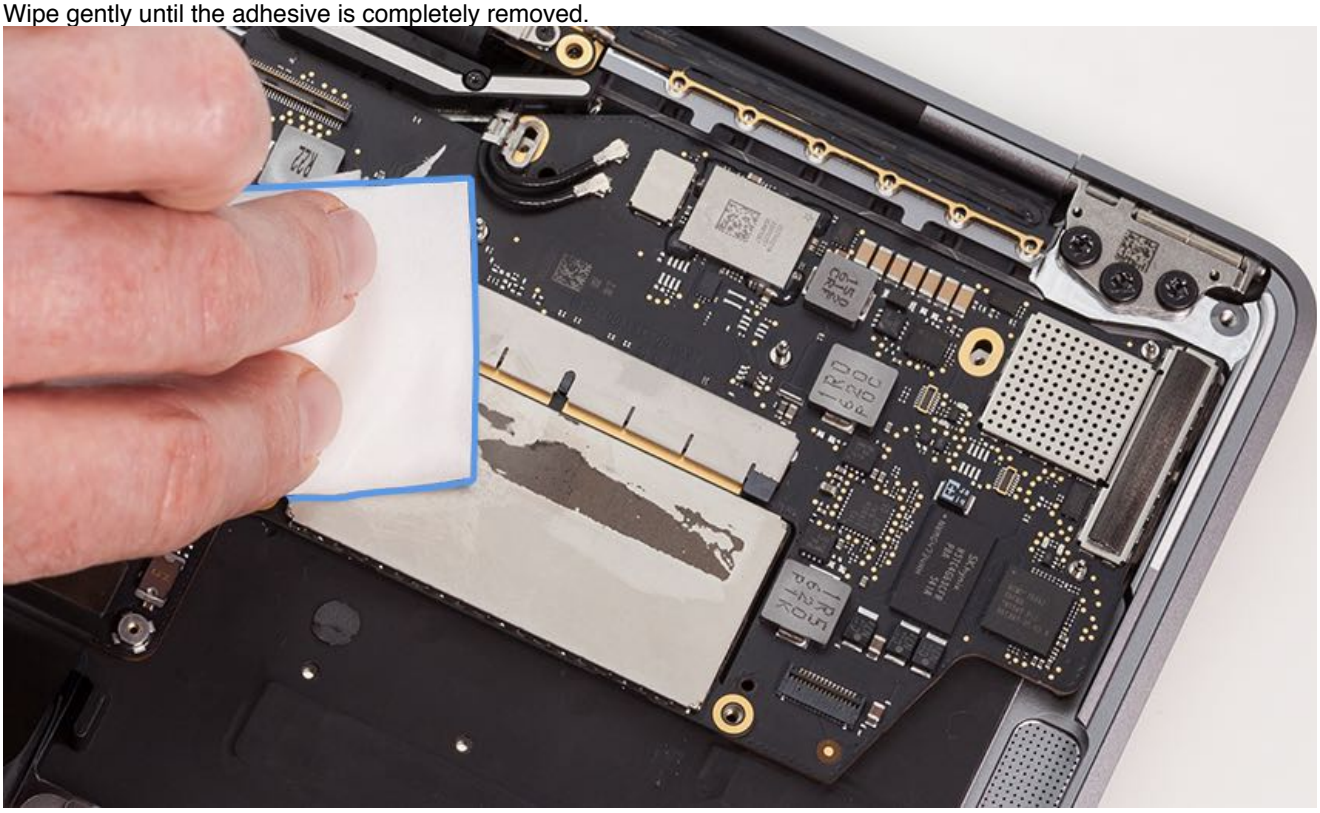
Steps For Reassembly

1. Align the flash storage card in front of the connector slot on the logic board.
2. Without tilting the card, slide it into the connector until it clicks into place.

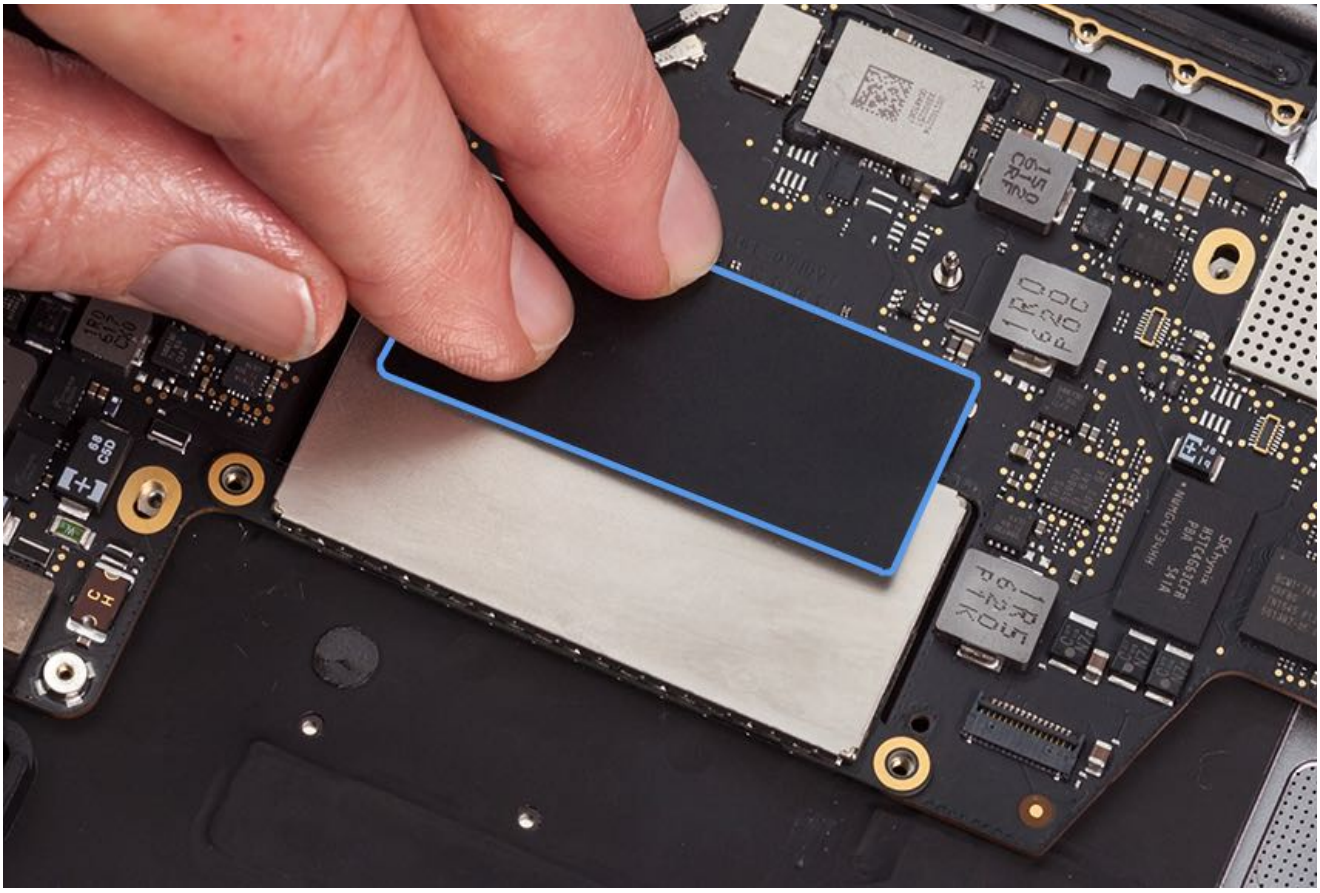




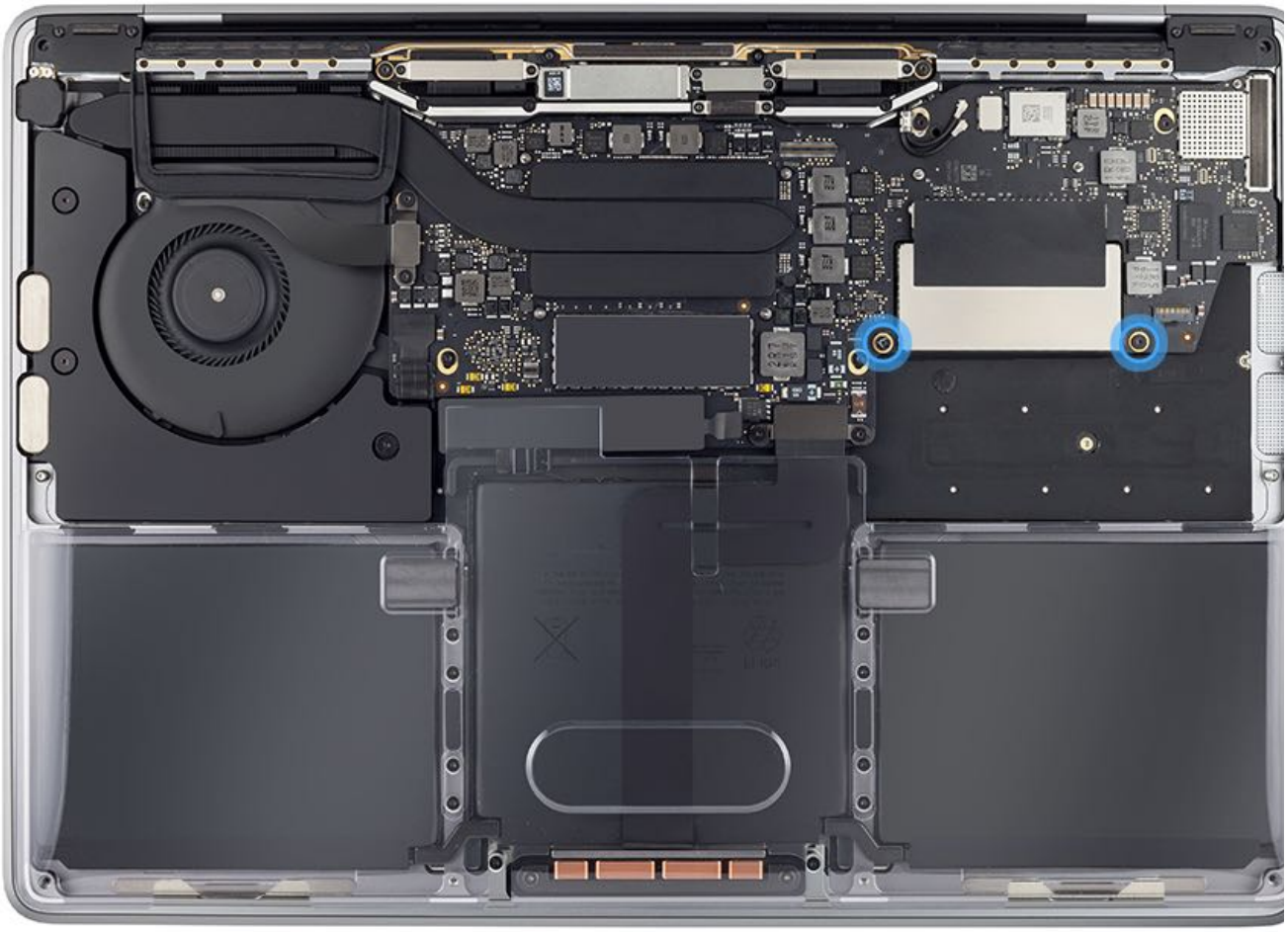
3. Use the IPA wipe that came with the service part to clean off any adhesive residue on the connector and the card. Wipe gently until the adhesive is completely removed.



4. Apply a new strip of the shield tape across the top of the flash storage card and the logic board connector.



5. Reinstall two T5 screws (923-01182) to flash storage card.



6. Reinstall the left speaker.

7. Reconnect the battery flex cable. Secure the locking lever, pressing it flat.
8. Remove the battery cover.
9. Reinstall the bottom case.
10. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
11. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Reinstalling Software That Came with the Computer

Reinstalling Software That Came with the Computer

This procedure requires an Internet connection.

Note: In some situations, a user may have set a firmware password via a feature such as Find My Mac or FileVault. The user must know the firmware password in order to reinstall OS X or macOS. If the user cannot remember the password, then refer to the technician instructions in article HT203409: If you lost or forgot your firmware password.

Important: Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing OS X or macOS. Apple is not responsible for any loss of data.

1. Choose Apple menu > Restart, then hold down the Command (âŒ˜) and R keys while the computer restarts.
   Note: To force OS X Lion or later, or macOS Sierra, into Internet Recovery, press and hold the Command-Option-R key combination while starting up the computer.
2. If the computer is not connected to the Internet, choose a network from the Wi-Fi menu (in the top-right corner of the screen).
3. Select "Reinstall OS X" (or macOS), then click Continue.
4. Follow the onscreen instructions. In the pane where you select a disk, select your current OS X or macOS disk (in most cases, it is the only one available).
5. To start the installation, click Install.

Check for and apply the latest software and firmware updates.

For more information, refer to article HT201314: About macOS Recovery.

Cable Cowlings

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

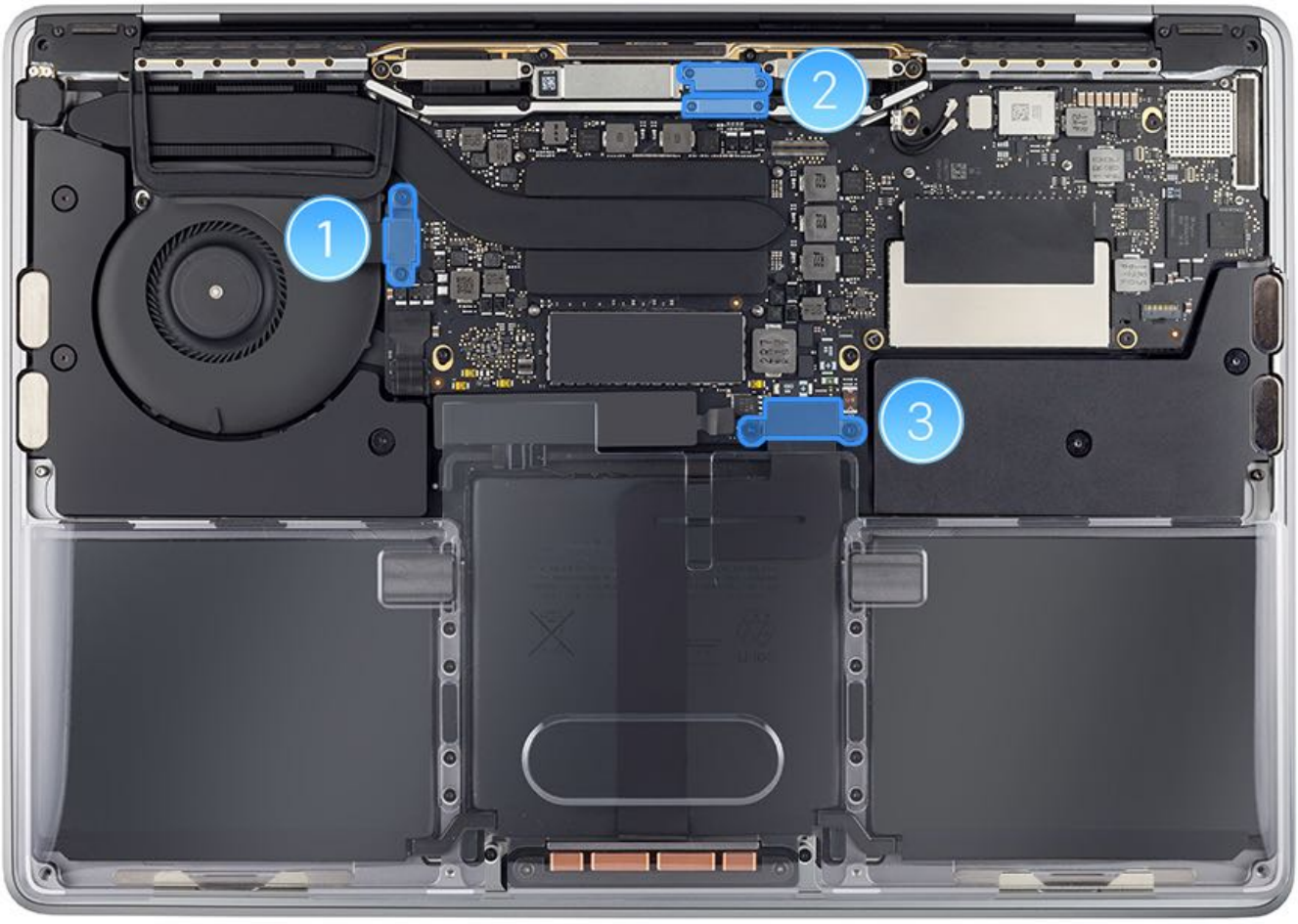
- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery

Cowling Locations:

1. Audio flex cable cowling
2. Embedded DisplayPort (eDP) cable cowlings
3. Trackpad flex cable cowling



Tools

- ESD wrist strap
- Black stick
- Torx T3 screwdriver (magnetized)

- Torx T5 screwdriver (magnetized)
- Battery cover (923-01318)

Steps For Removal

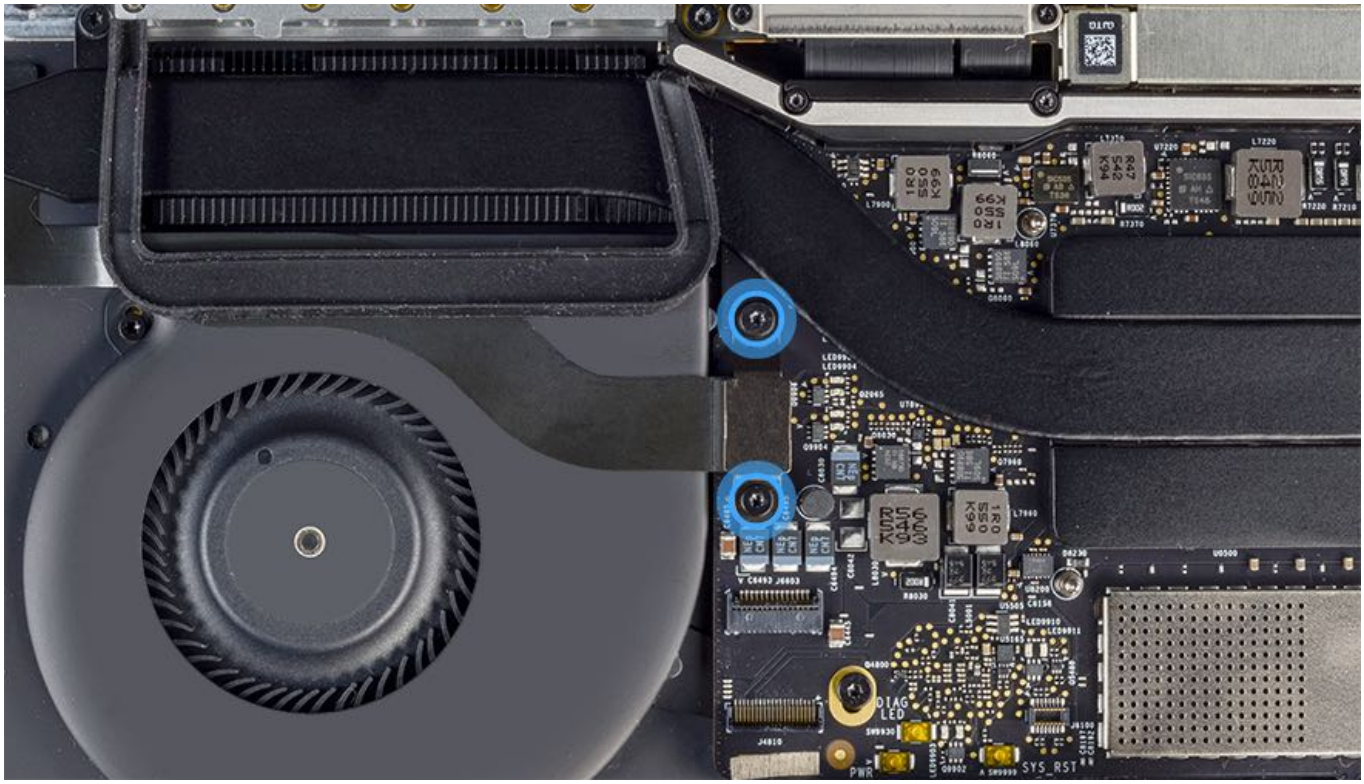
1: Audio Flex Cable Cowling

After disconnecting the battery flex cable, remove two T5 audio flex cable cowling screws.
Note: The upper cowling screw is longer.

- 923-01296

- 923-01277

- 923-01177



2: Embedded DisplayPort (eDP) Cable Cowlings

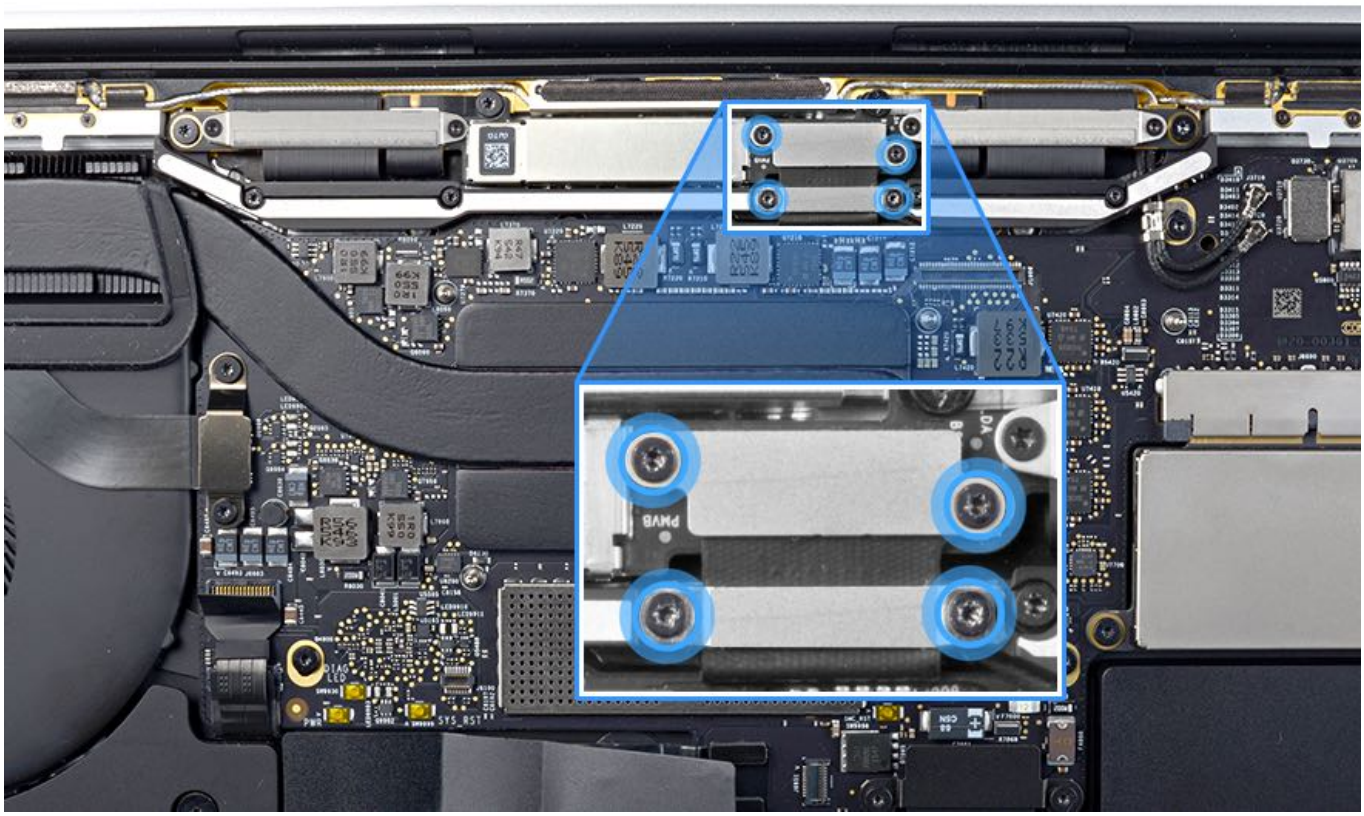
After disconnecting the battery flex cable, remove four T3 screws on the two eDP cable cowlings.
Note: The upper cowling uses the shorter screws.

- Upper, 923-01310

- 923-01285

- Lower, 923-01308

- 923-01284

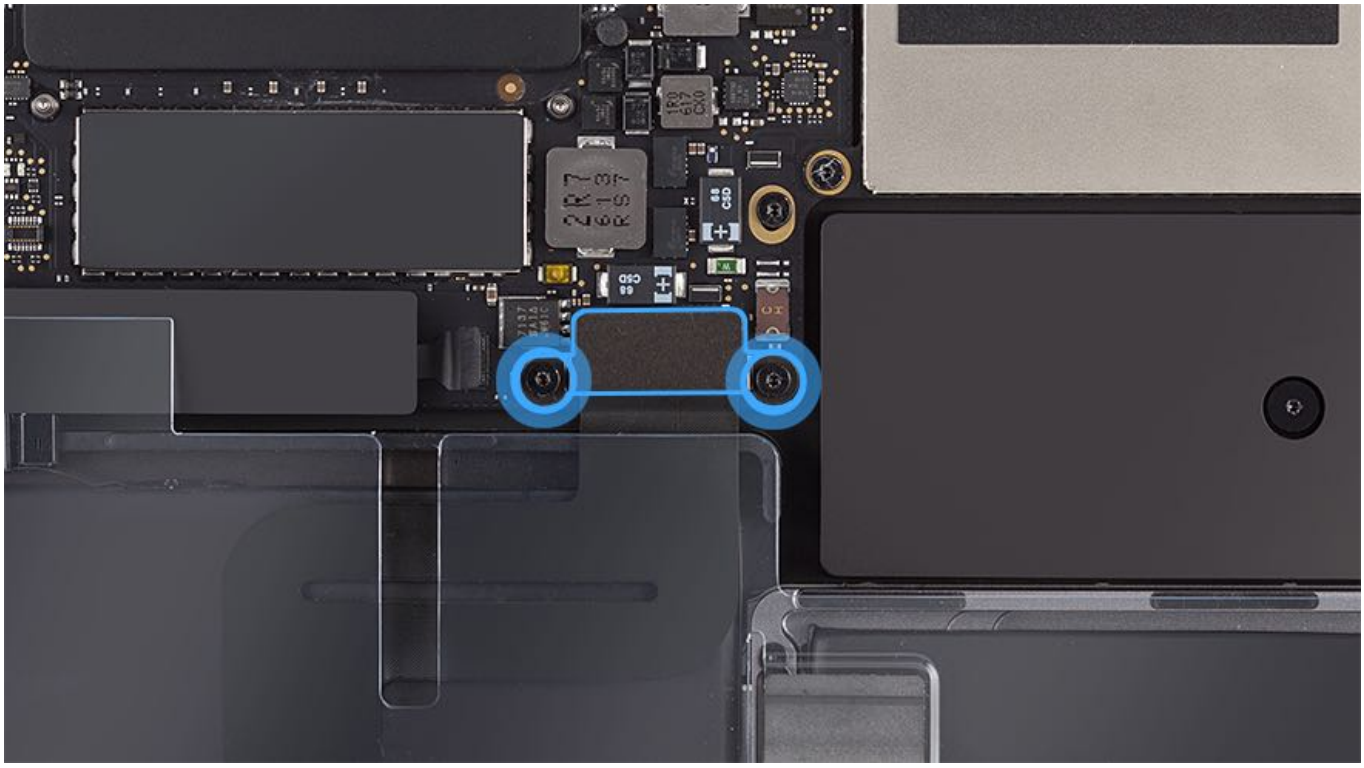


3: Trackpad Cable Cowling

After disconnecting the battery flex cable, remove two T5 trackpad cable cowling screws. Set the cowling aside.

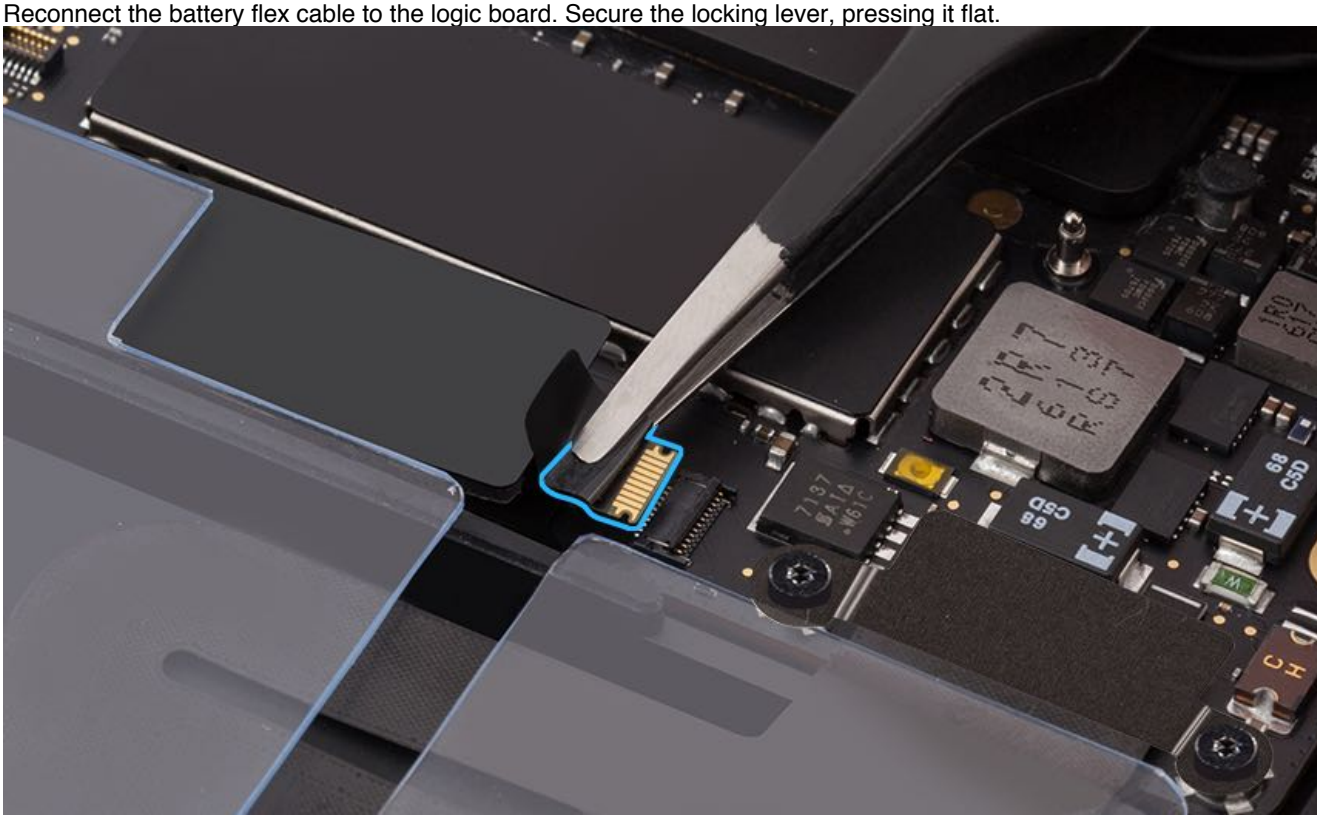
- 923-01303

- 923-01281



Steps For Reassembly

1. Follow cowling removal steps in reverse order.
2. Reconnect the battery flex cable to the logic board. Secure the locking lever, pressing it flat.



3. Remove the battery cover.
4. Reinstall the bottom case.
5. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
6. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Clutch Covers

First Steps

Warning:

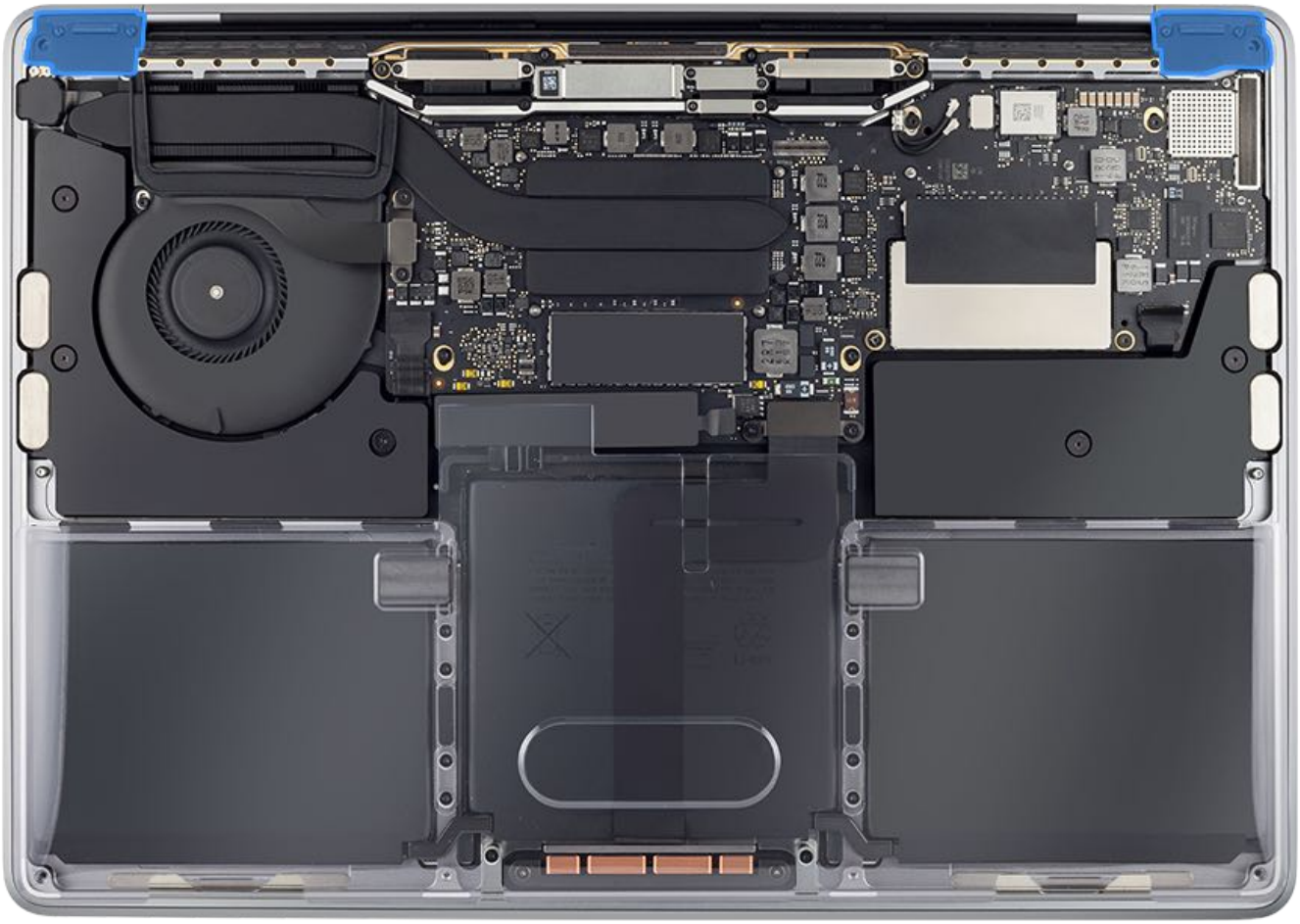
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery

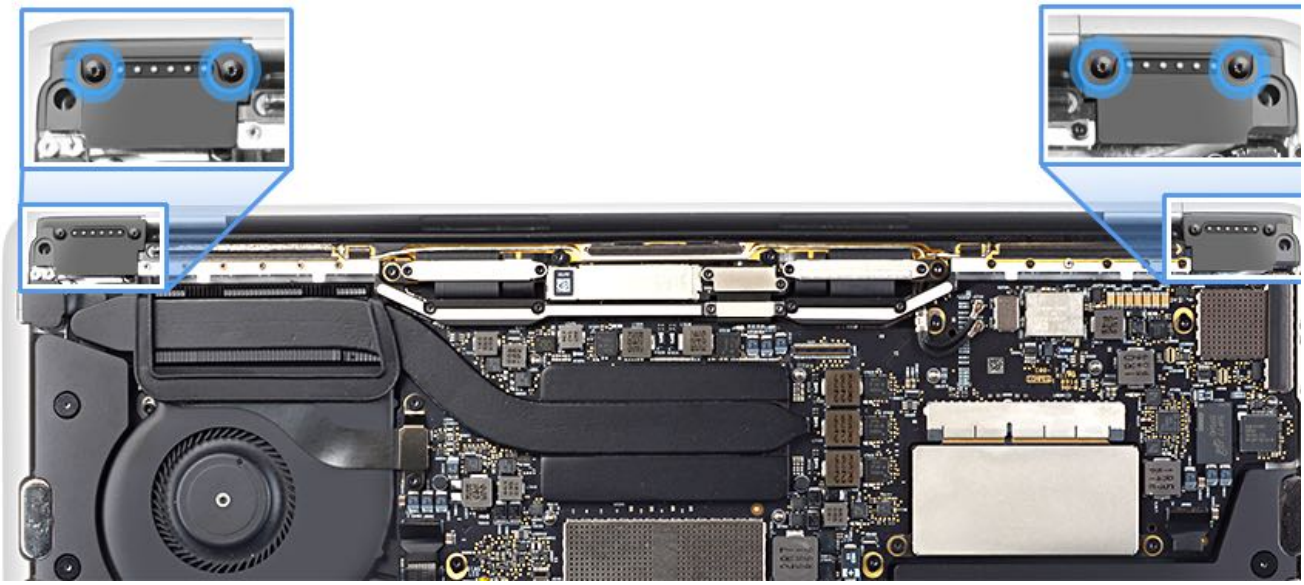


Tools

- ESD wrist strap
- Black stick
- Torx T3 screwdriver (magnetized)
- Battery cover (923-01318)

Steps For Removal

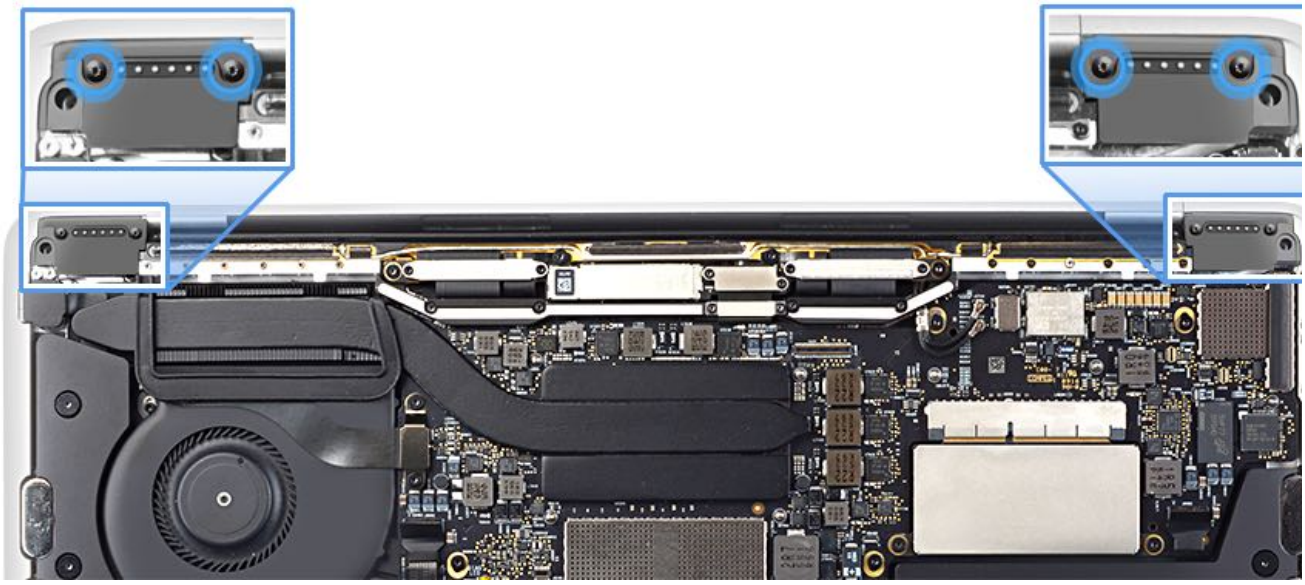
1. Remove two T3 screws (923-01286) from each clutch cover.



2. Use a black stick to remove the clutch covers from the top case.

Steps For Reassembly

1. Reinstall each clutch cover so the top edge of the clutch cover seats under the top edge of the top case.
2. Reinstall two T3 screws (923-01286) to each clutch cover.



3. Reconnect the battery flex cable to the logic board. Secure the locking lever, pressing it flat.
4. Remove the battery cover.
5. Reinstall the bottom case.
6. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
7. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Timing Controller (TCON) Connector

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

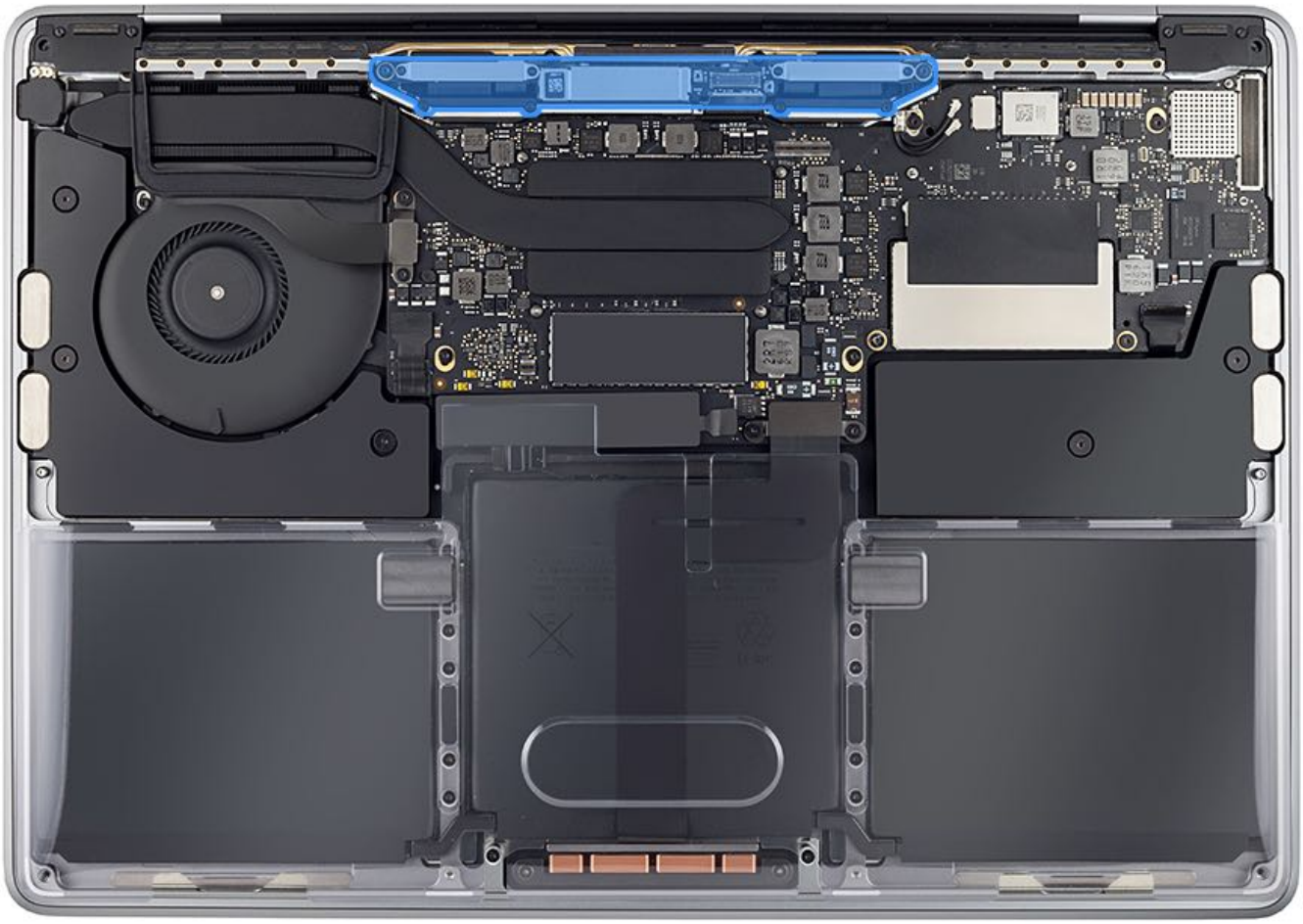
Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Embedded DisplayPort (eDP) cowlings

Note: The TCON board is part of the display assembly and is not a separately available part. The TCON connector needs to be disconnected to remove the vent/antenna module, eDP flex cable, and the display assembly.



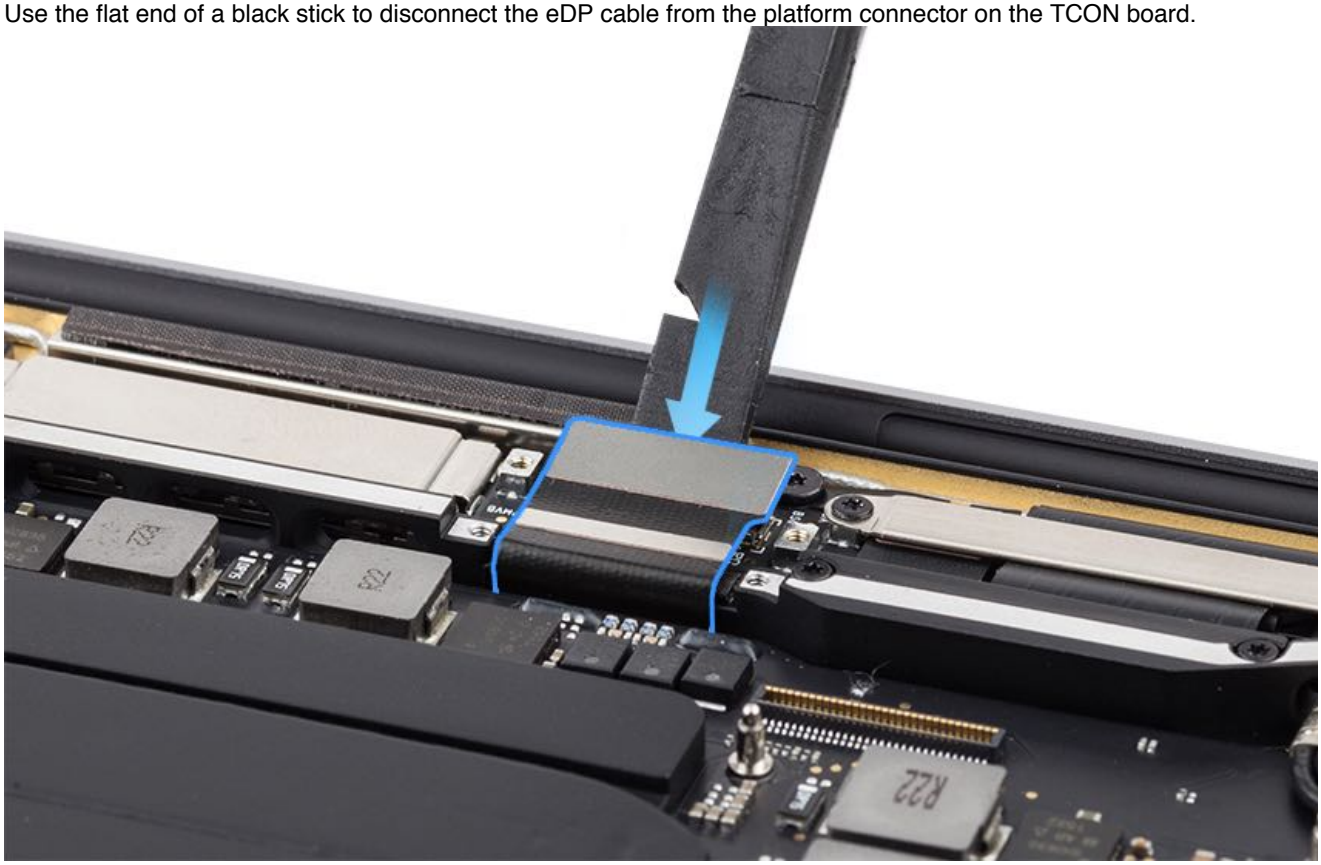
Tools

- ESD wrist strap
- Black stick
- Torx T3 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- ESD-safe plastic or nylon tweezers

- Battery cover (923-01318)

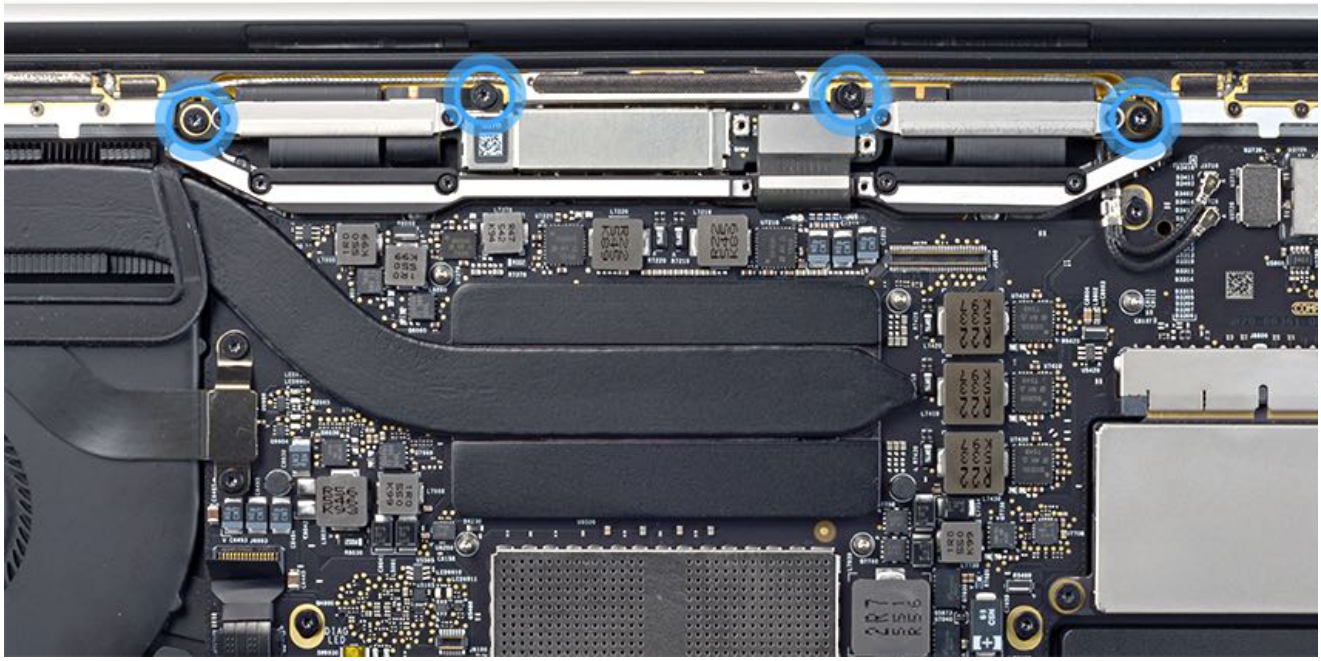
Steps For Removal

1. Use the flat end of a black stick to disconnect the eDP cable from the platform connector on the TCON board.

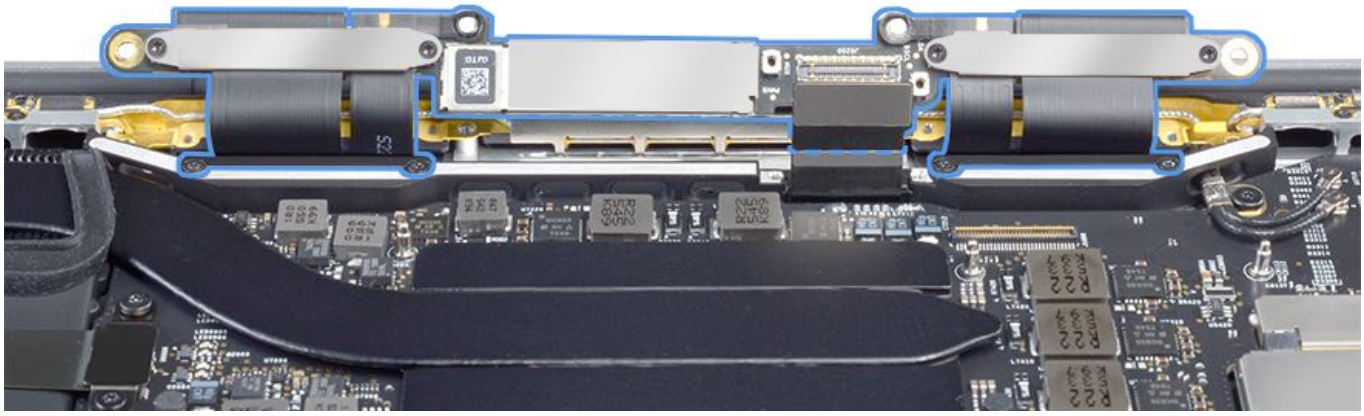


2. Remove four T5 screws on the TCON board. The two outer screws are shoulder screws.
   923-01277

   923-01282

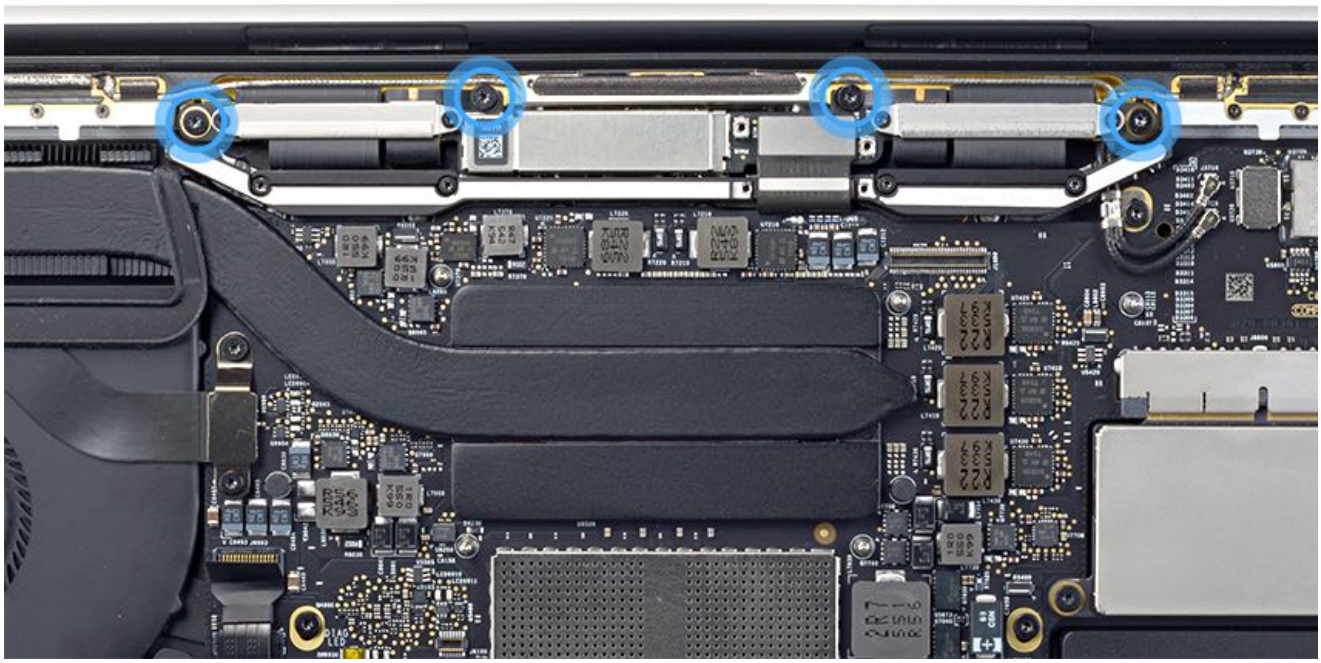


Note: The TCON board is part of the display assembly, it can’t be removed.

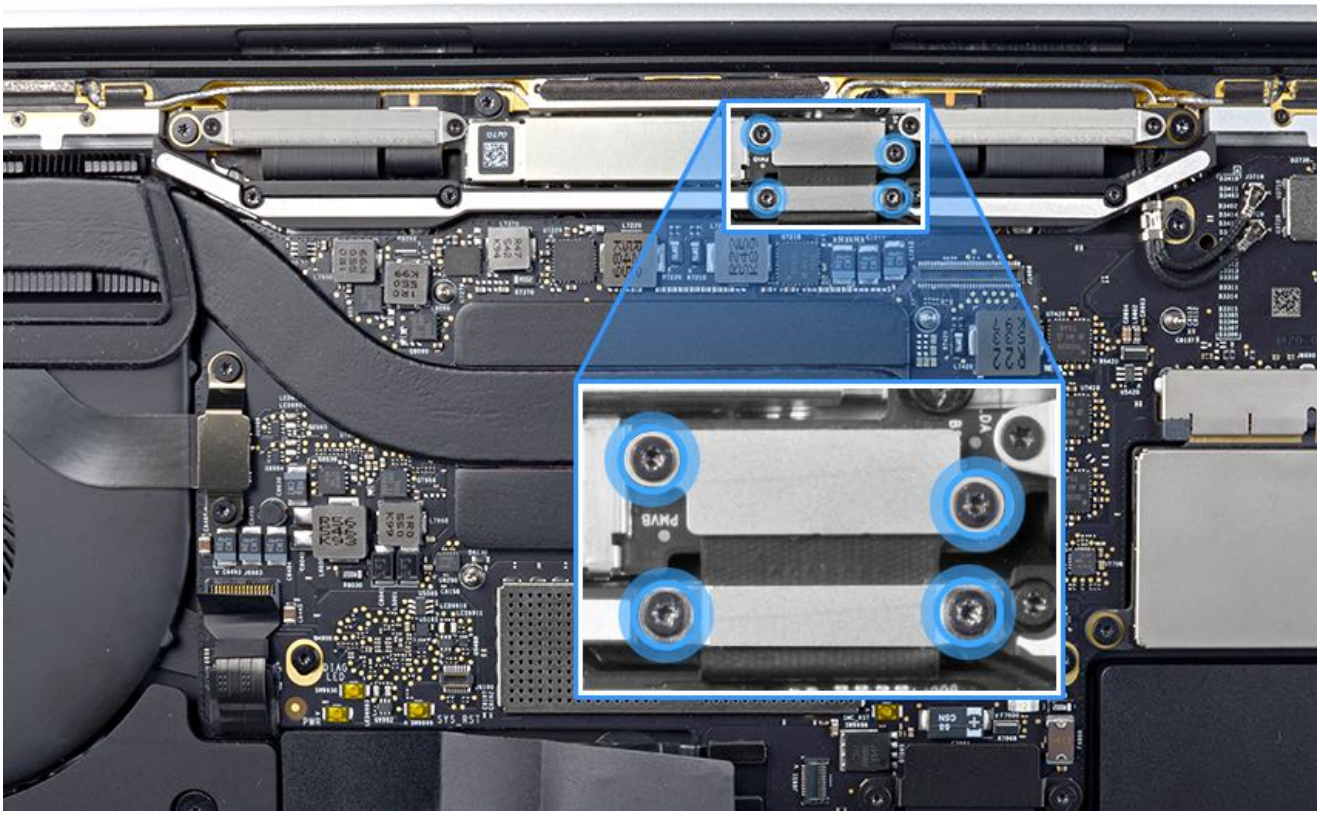


Steps For Reassembly

1. Reinstall the four T5 TCON board screws. The two outer TCON screws are shoulder screws.



2. Reconnect the eDP flex cable. Press down evenly to seat the eDP cable on the TCON board.
3. Reinstall the two eDP flex cable cowlings and four T3 cowling screws. Make sure the gasket on the lower cowling makes contact with the eDP cable. **Note:** The upper cowling uses the shorter screws.



4. Reconnect the battery flex cable to the logic board.
5. Remove the battery cover.
6. Reinstall the bottom case.
7. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
8. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Vent/Antenna Module

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

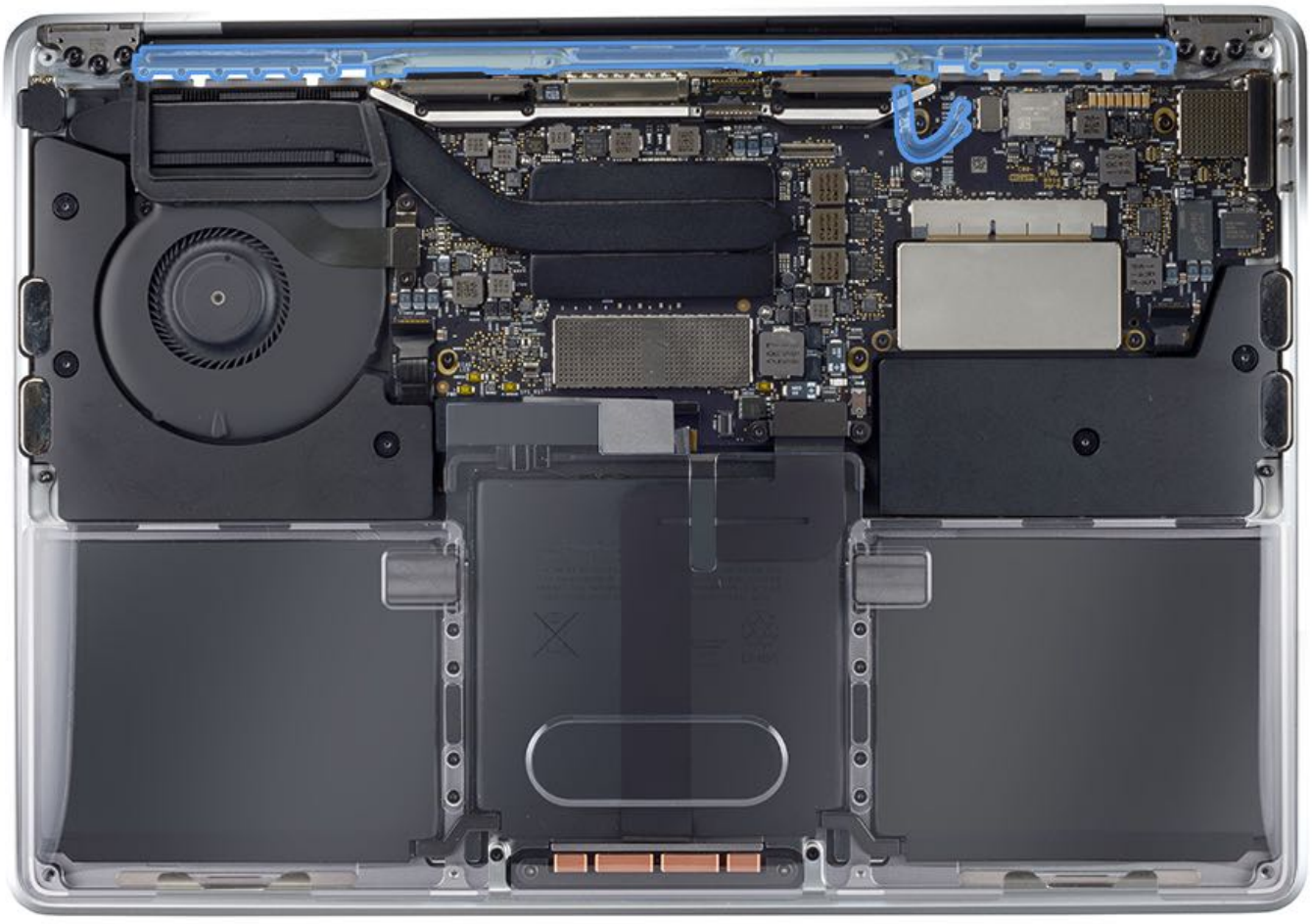
- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Embedded DisplayPort (eDP) cowlings
- Clutch covers
- TCON connector

For video instruction, refer to article SV309: Vent/Antenna Module Replacement Video.

To get a better idea of what you are removing/replacing, the vent/antenna module looks like this:

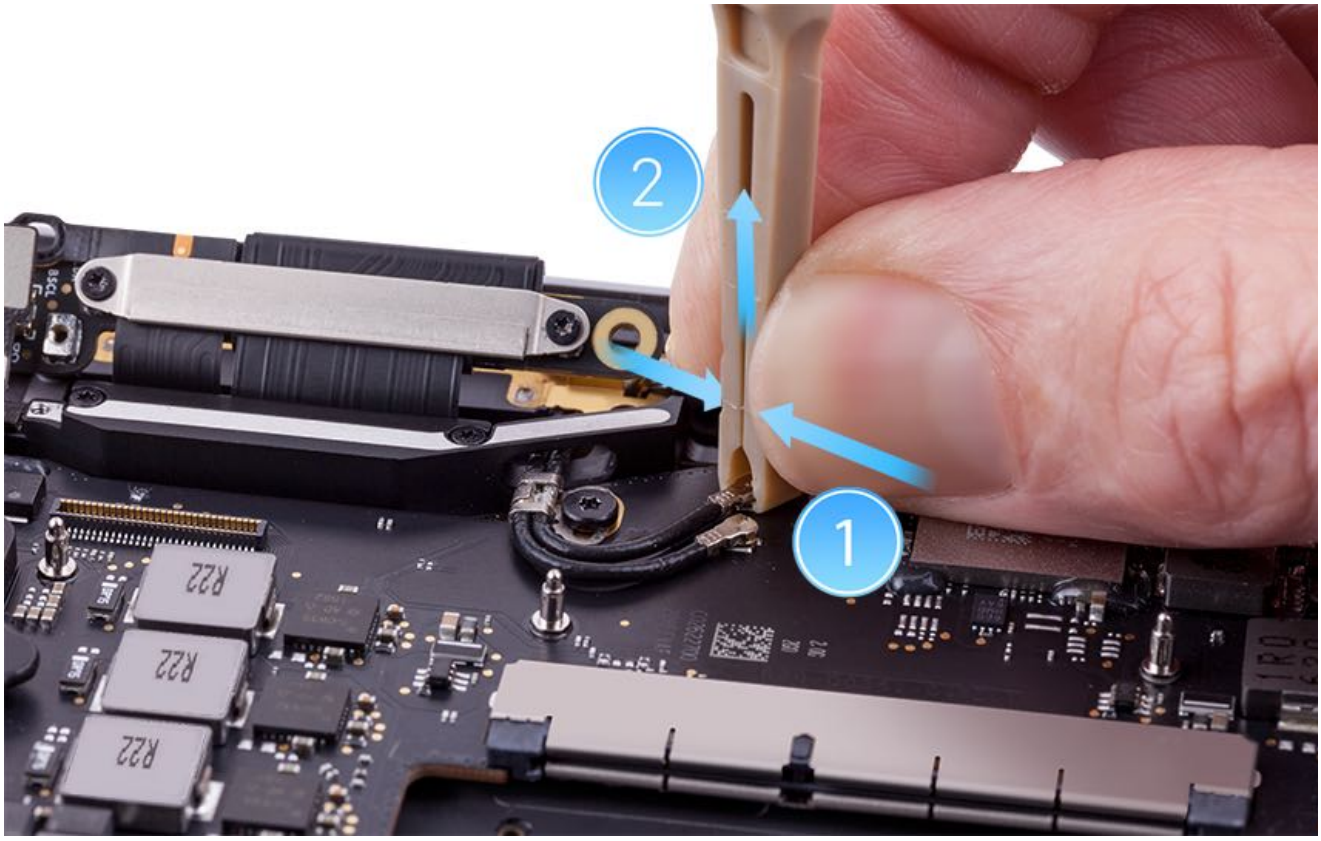


Tools

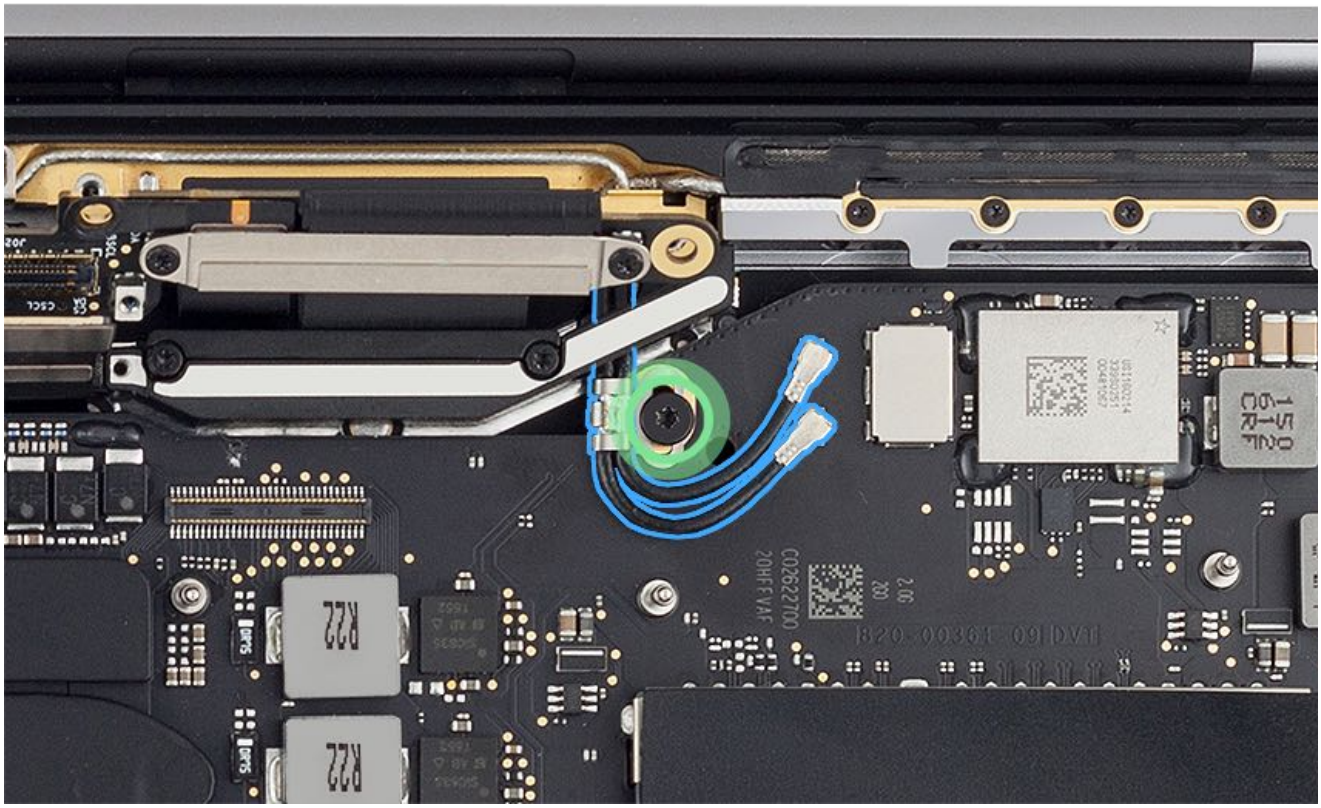
- Antenna tool, optional, (923-01322)
- Black stick
- Torx T5 screwdriver (magnetized)
- Torque driver (blue), 0.65kgf-cm (923-0448)
- Torx security bit (923-0247)
- ESD-safe plastic or nylon tweezers
- ESD wrist strap
- Battery cover (923-01318)

Steps For Removal

1. With the battery cover installed and the battery cable already disconnected, use a tweezers or the antenna tool to grasp the head of the wireless antenna (1). Pinch the antenna tool arms, then lift the antenna tool straight up (2) to disconnect the antenna from the logic board. Repeat the process on the other antenna. **Caution:** The antenna head may disconnect forcefully, so use your other hand to soften the release and protect the antenna cable.

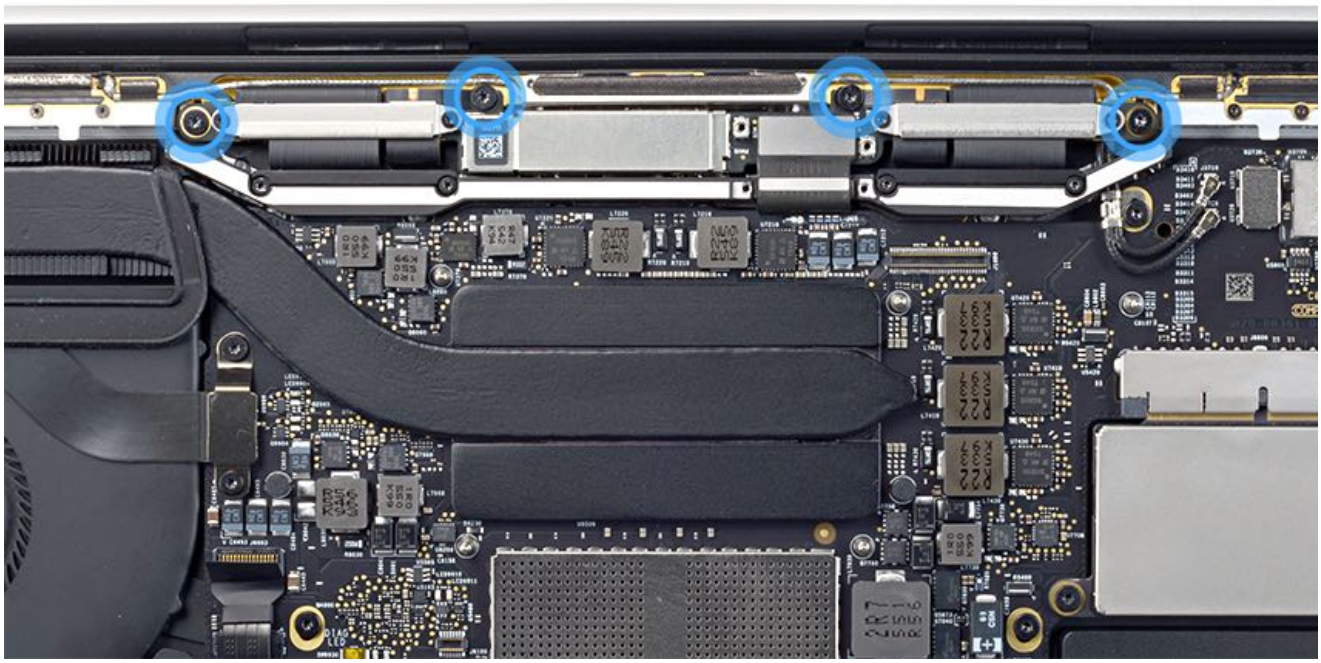


2. Remove the T5 antenna screw (923-01184).

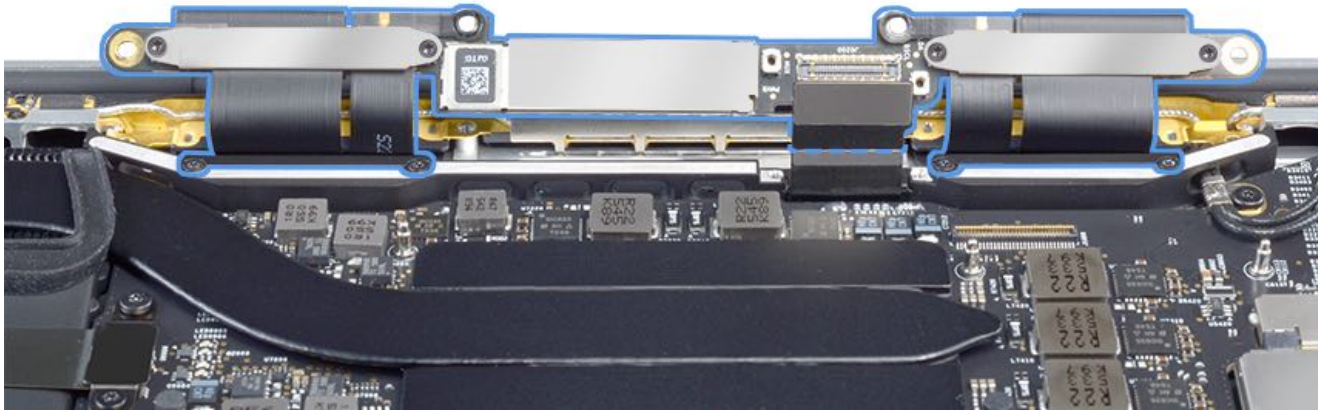


3. Remove four T5 screws on the TCON board. The two outer screws are shoulder screws.
923-01277 for 2 inner screws

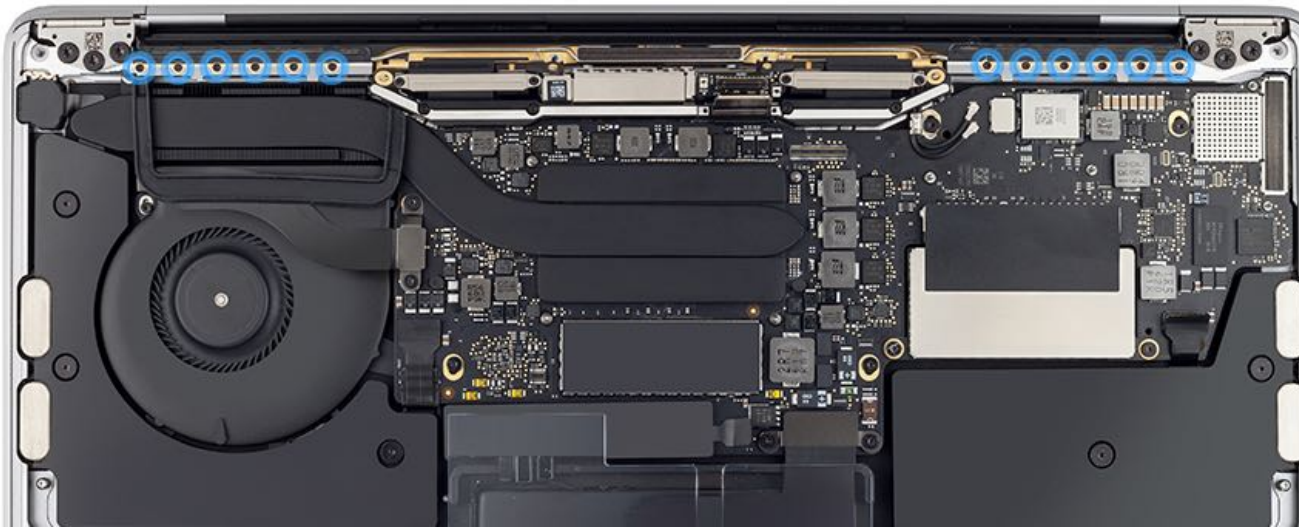
923-01282 for 2 outer screws



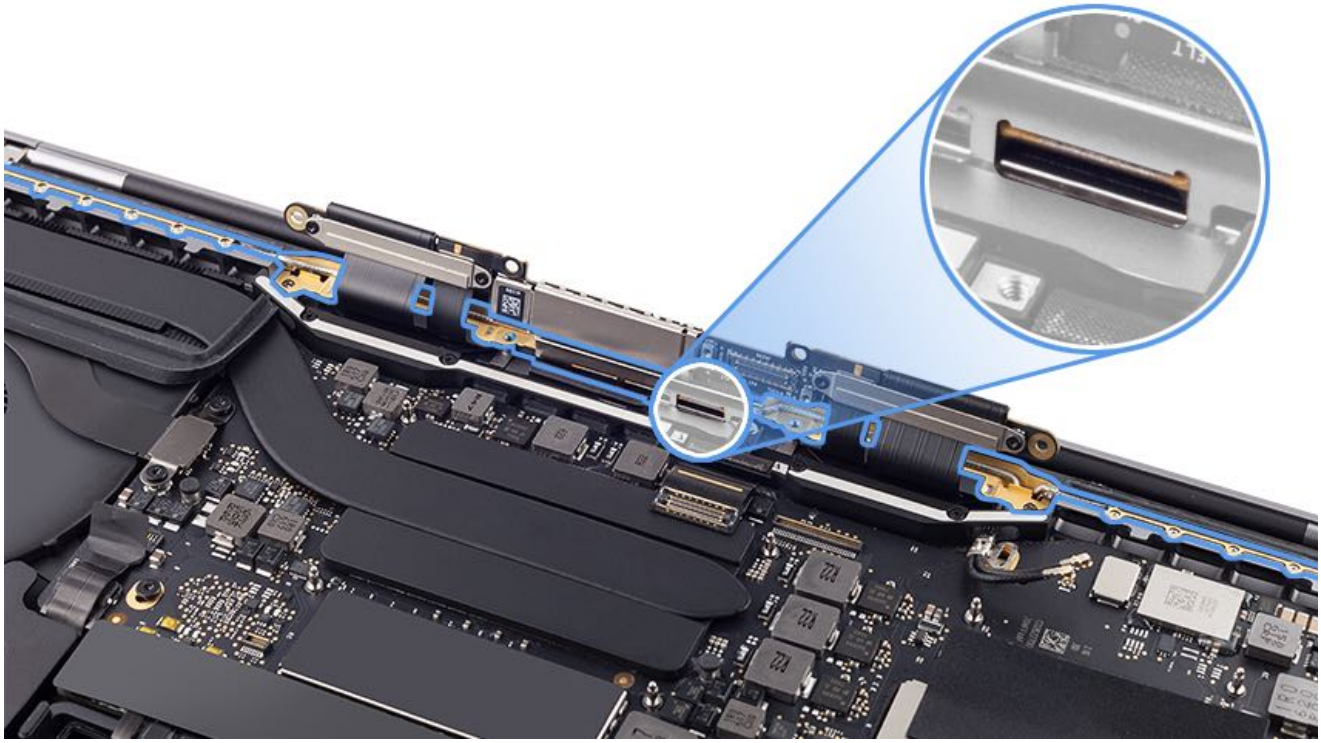
Note: The TCON board is part of the display assembly module, it can’t be removed. When you remove the TCON screws, you can access the vent/antenna module.



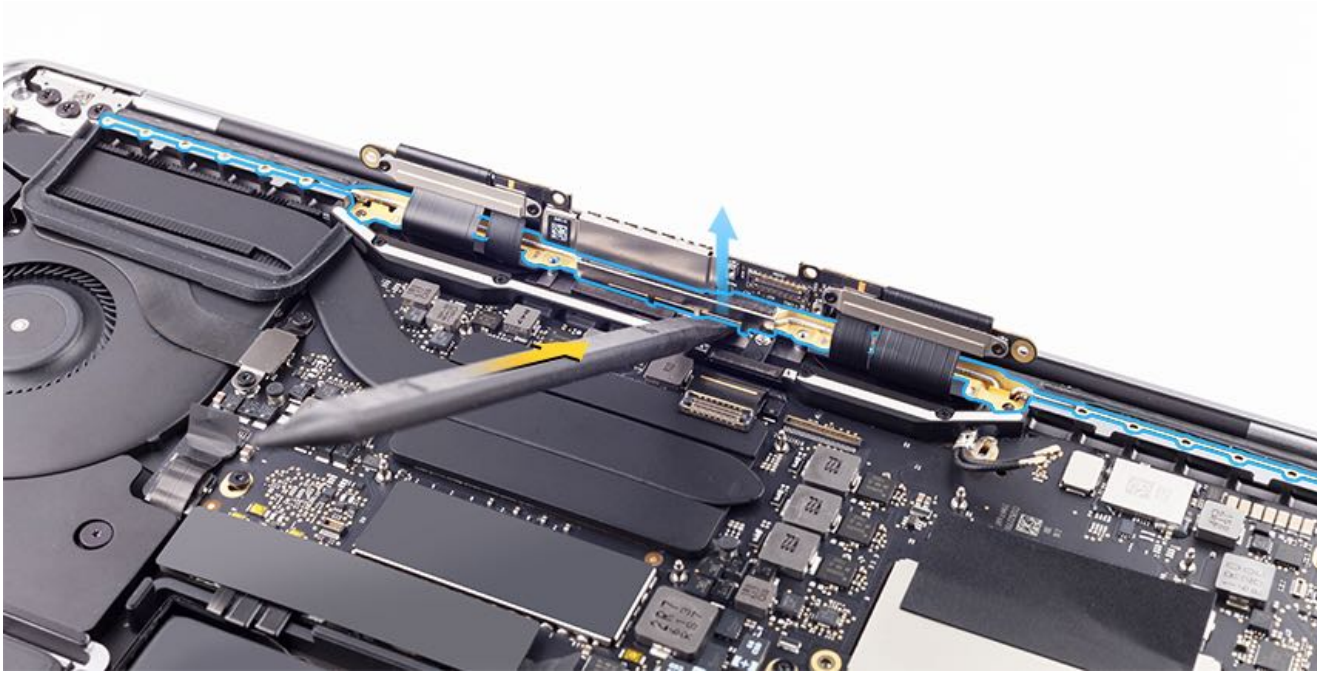
4. Use the torque driver with the Torx security bit to remove twelve 1IPR screws (923-01191) on the vent/antenna module.



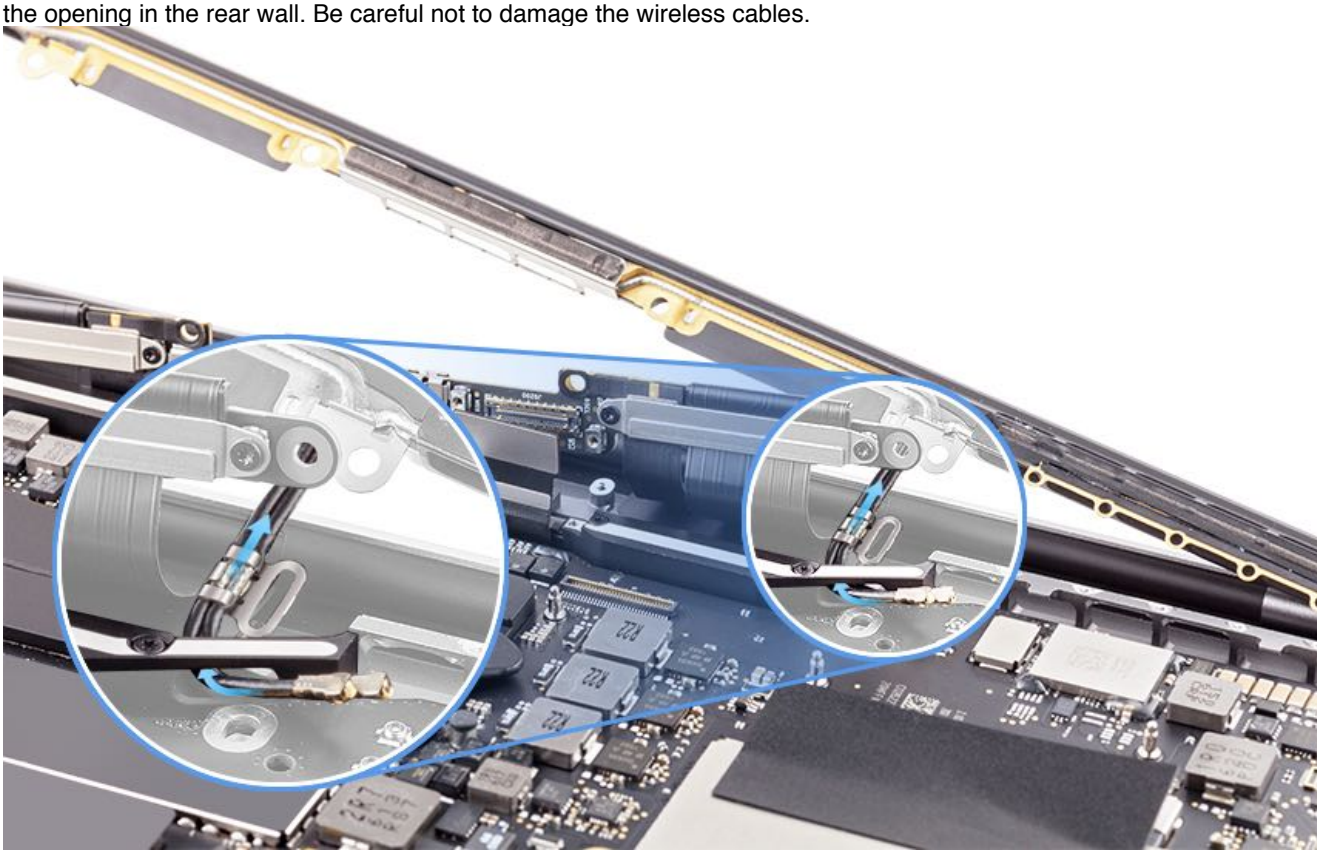
5. Tilt the TCON board toward the display hinge. Locate the vent opening near the eDP flex cable.



6. Insert the flat end of a black stick into the vent. Press the black stick down to lift the vent/antenna module. You should hear a slight click when the vent/antenna module unclips from the top case.
   Caution: When applying force with the black stick, avoid pressing the EDP cable. Lean the black stick on the rear wall instead. Gently support the vent/antenna module with your other hand to prevent any bend to the module.

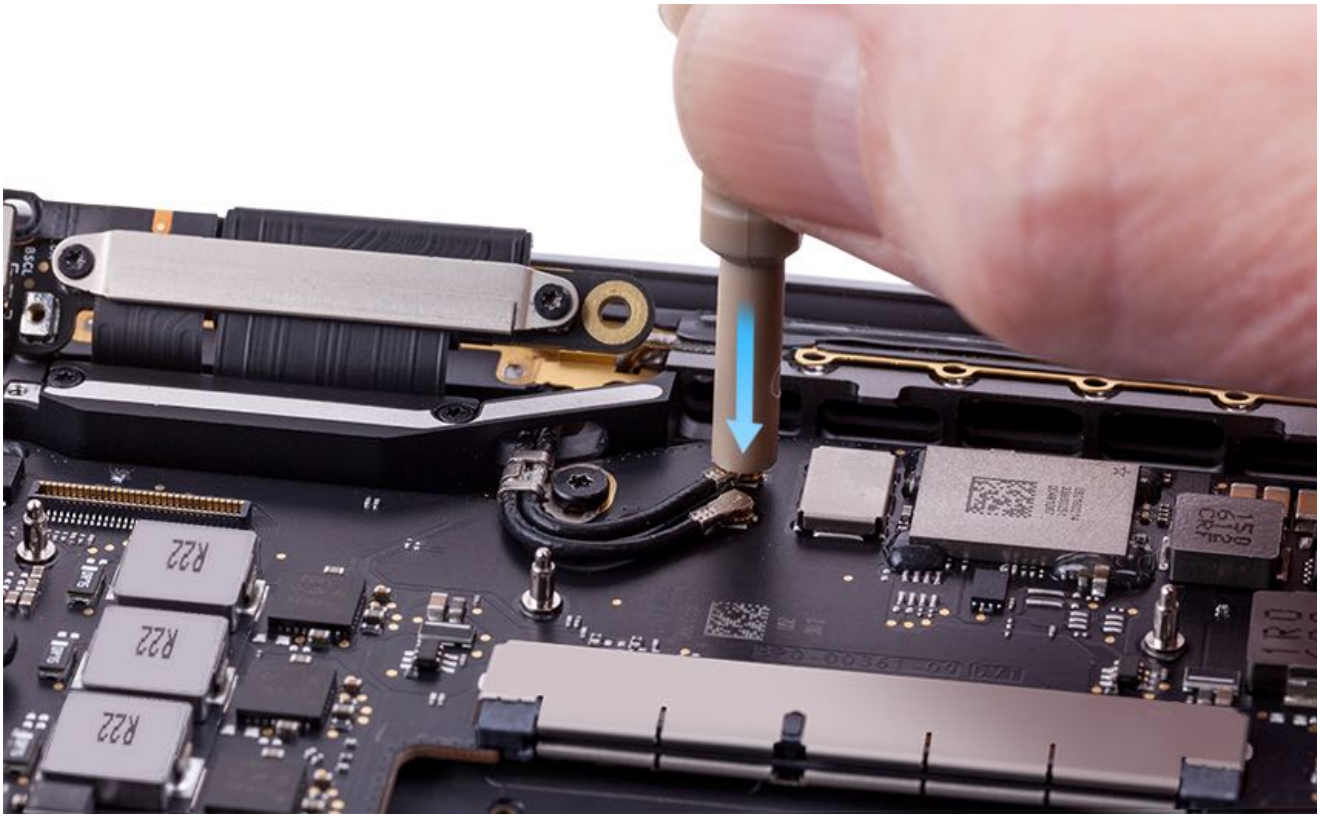


7. Carefully remove the vent/antenna module from the top case. Route the antenna ground clip and two antennas through the opening in the rear wall. Be careful not to damage the wireless cables.

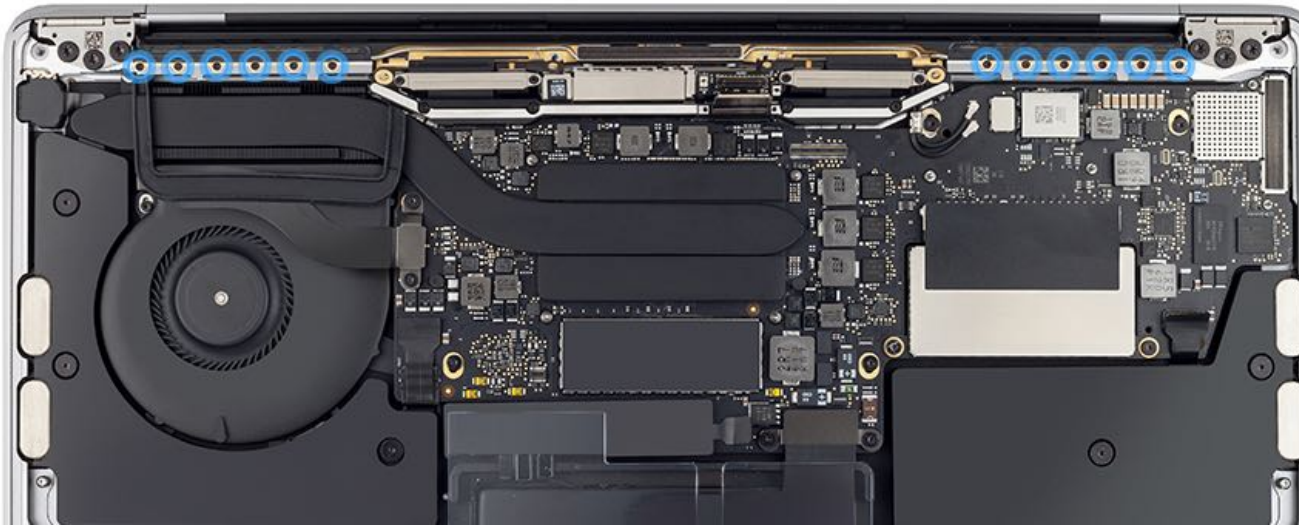


Steps For Reassembly

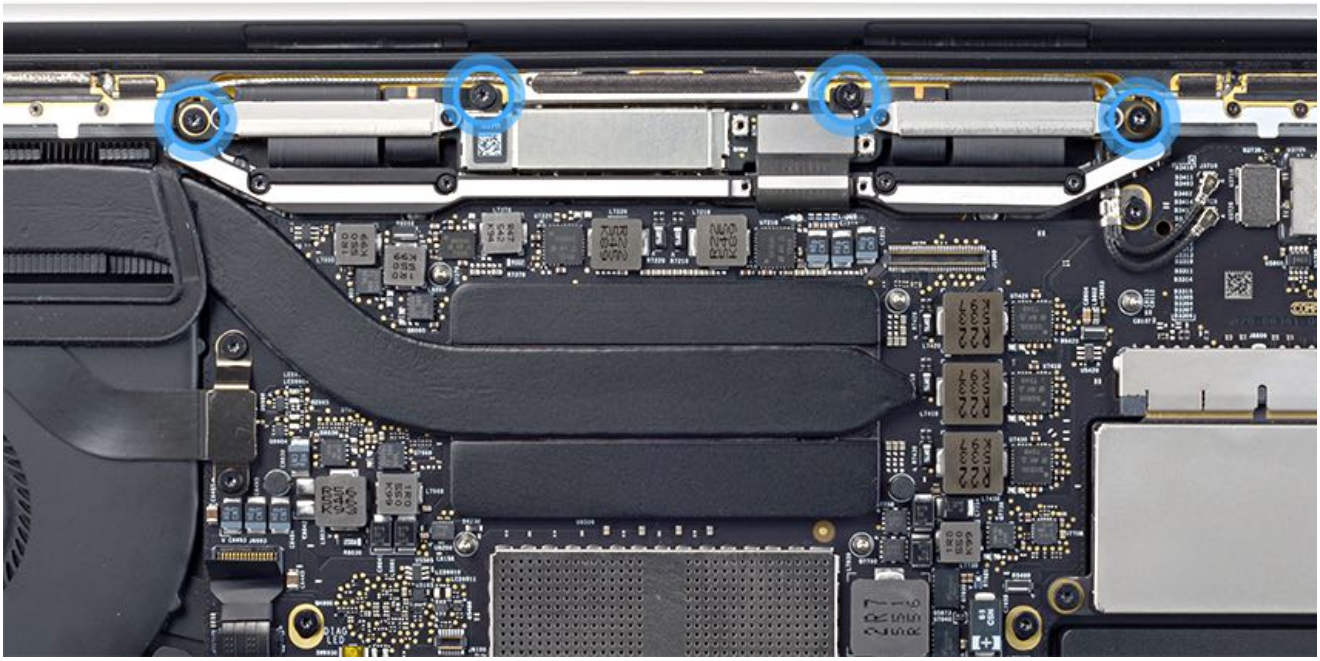
1. Route the two antennas and ground clip through the opening in the rear wall.
2. Position the vent/antenna module in the top case.
3. Gently press down in the middle of the vent/antenna module to seat the module into the top case. You should hear a slight click when the module attaches to the top case.
4. Reinstall the T5 antenna grounding screw. Then align the antenna heads over the connectors and use a tweezers or the antenna tool to press the two antenna heads onto the wireless connectors.



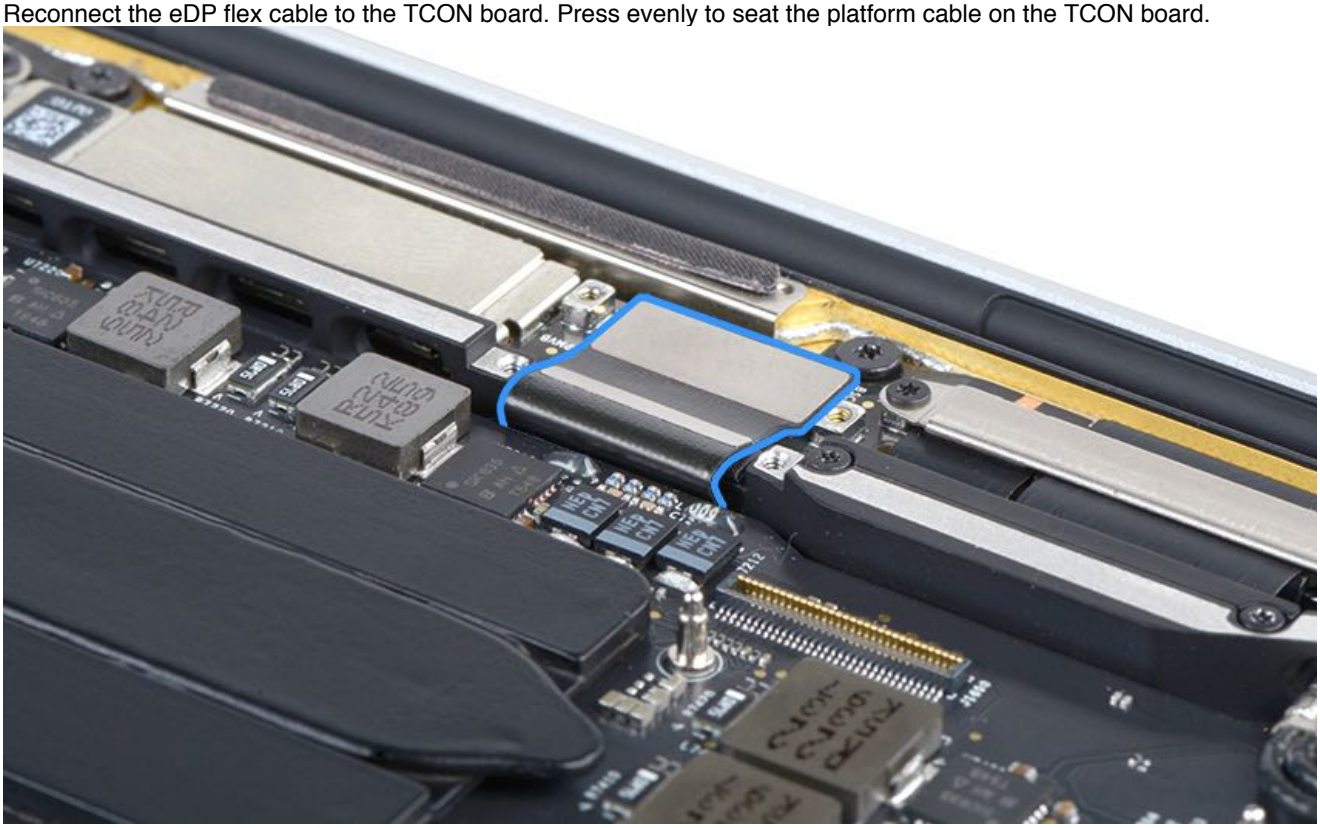
5. Using the torque driver, install the twelve 1IPR vent/antenna module screws. Turn each screw until the torque driver clicks (applies the correct torque).



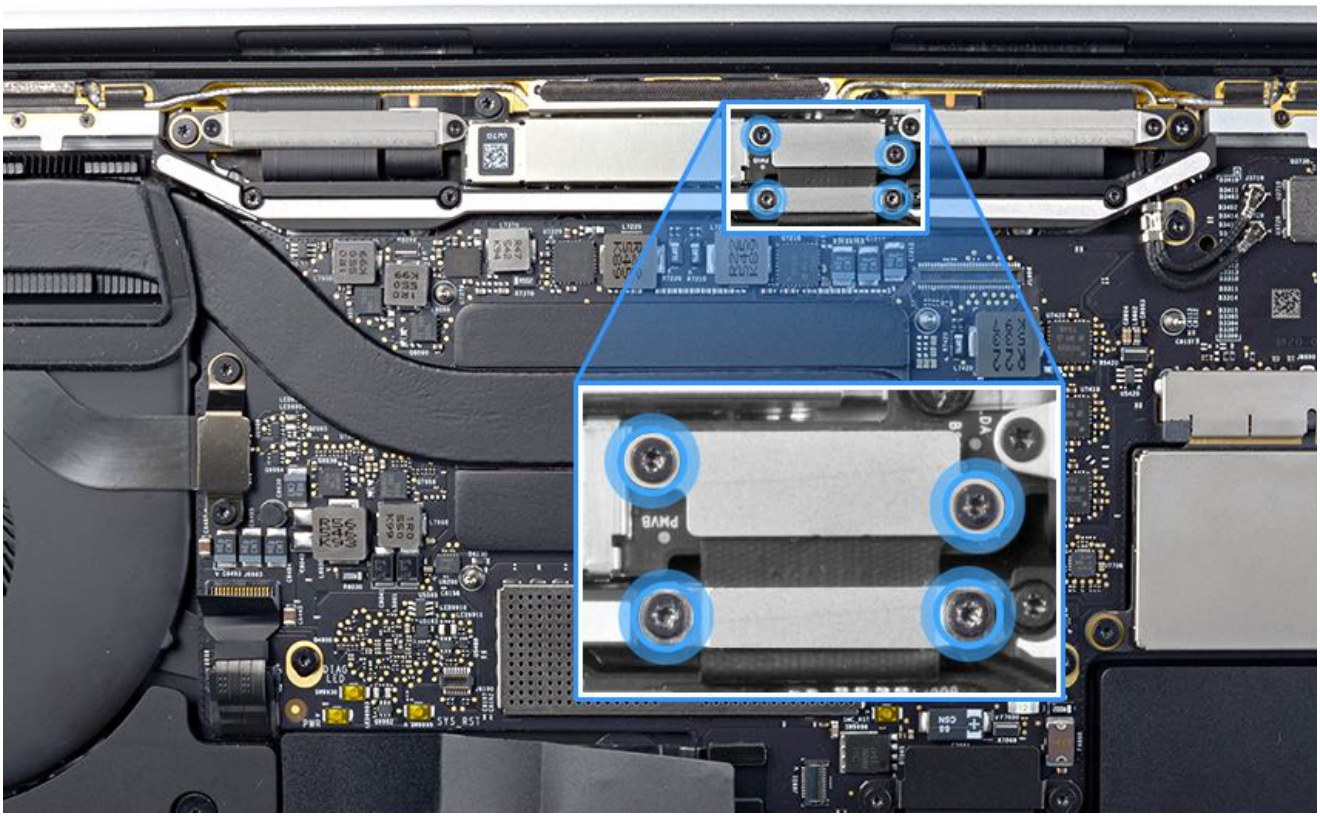
6. Reinstall the four T5 TCON board screws. **Note:** The shoulder screws are the two outer screws.



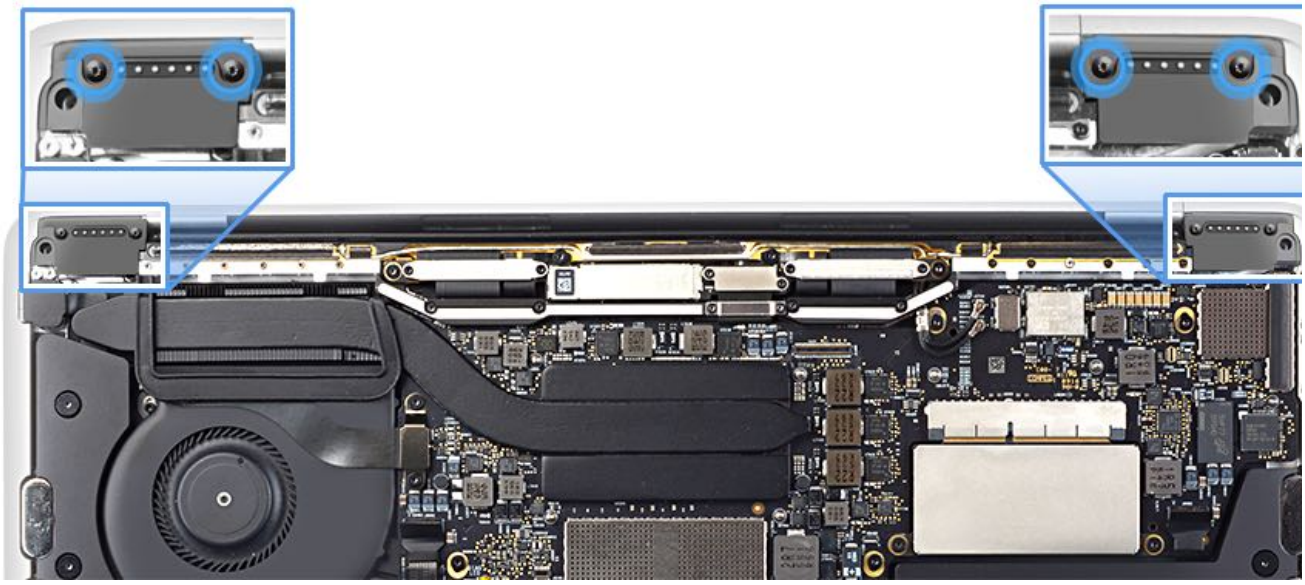
7. Reconnect the eDP flex cable to the TCON board. Press evenly to seat the platform cable on the TCON board.



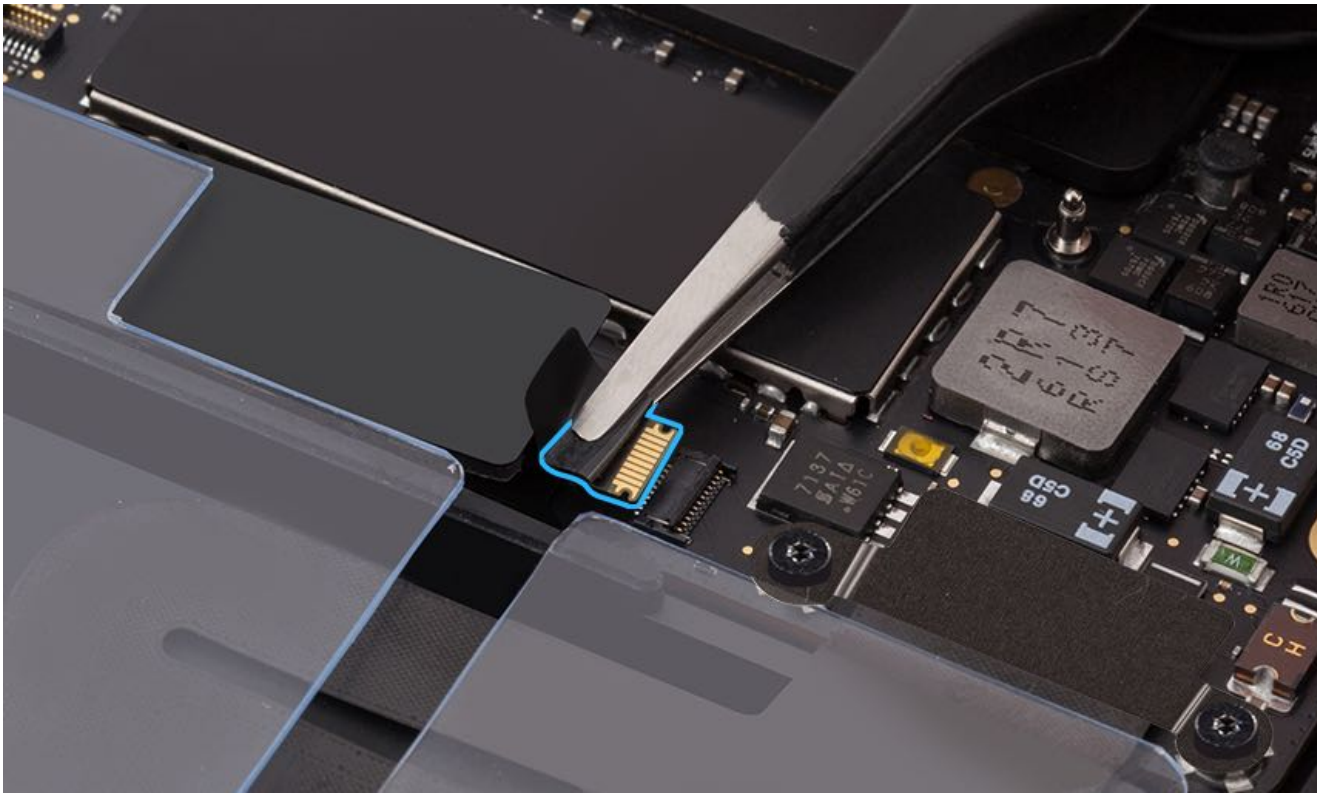
8. Reinstall the two eDP cable cowlings and four T3 cowlings screws. Make sure the gasket on the cowling makes contact with the eDP cable. **Note:** The upper cowling uses the shorter T3 screws.



9. Reinstall the clutch covers and four T3 screws.



10. Reconnect the battery flex cable to the logic board. Secure the locking lever, pressing it flat.



11. Remove the battery cover.
12. Reinstall the bottom case.
13. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
14. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Logic Board

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

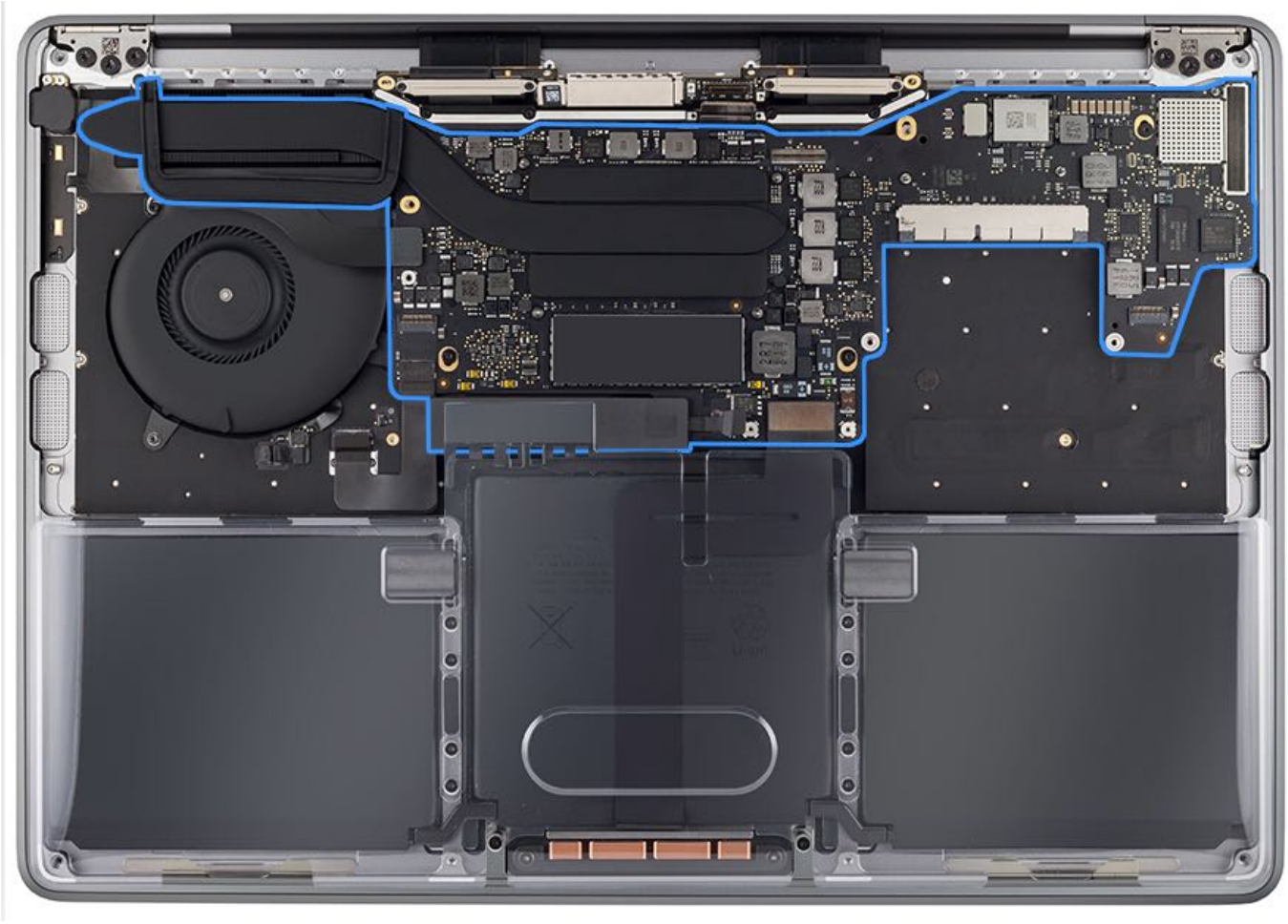
Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover, disconnect battery, and remove BMU screw
- Speakers
- Flash storage (optional)
- Embedded DisplayPort (eDP) cowlings
- Clutch covers
- TCON board screws
- Vent/antenna module

For video instruction, refer to article SV308: Logic Board Replacement Video.



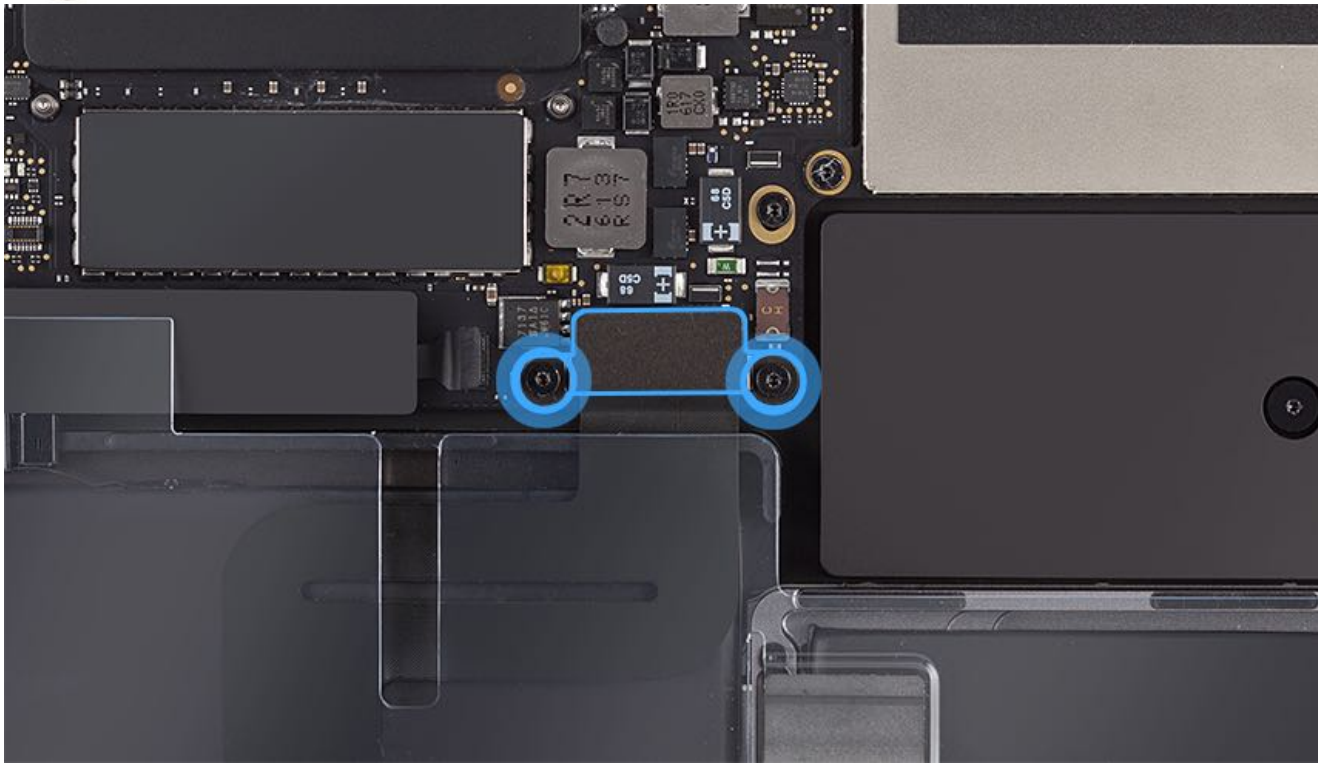
Tools

- ESD wrist strap

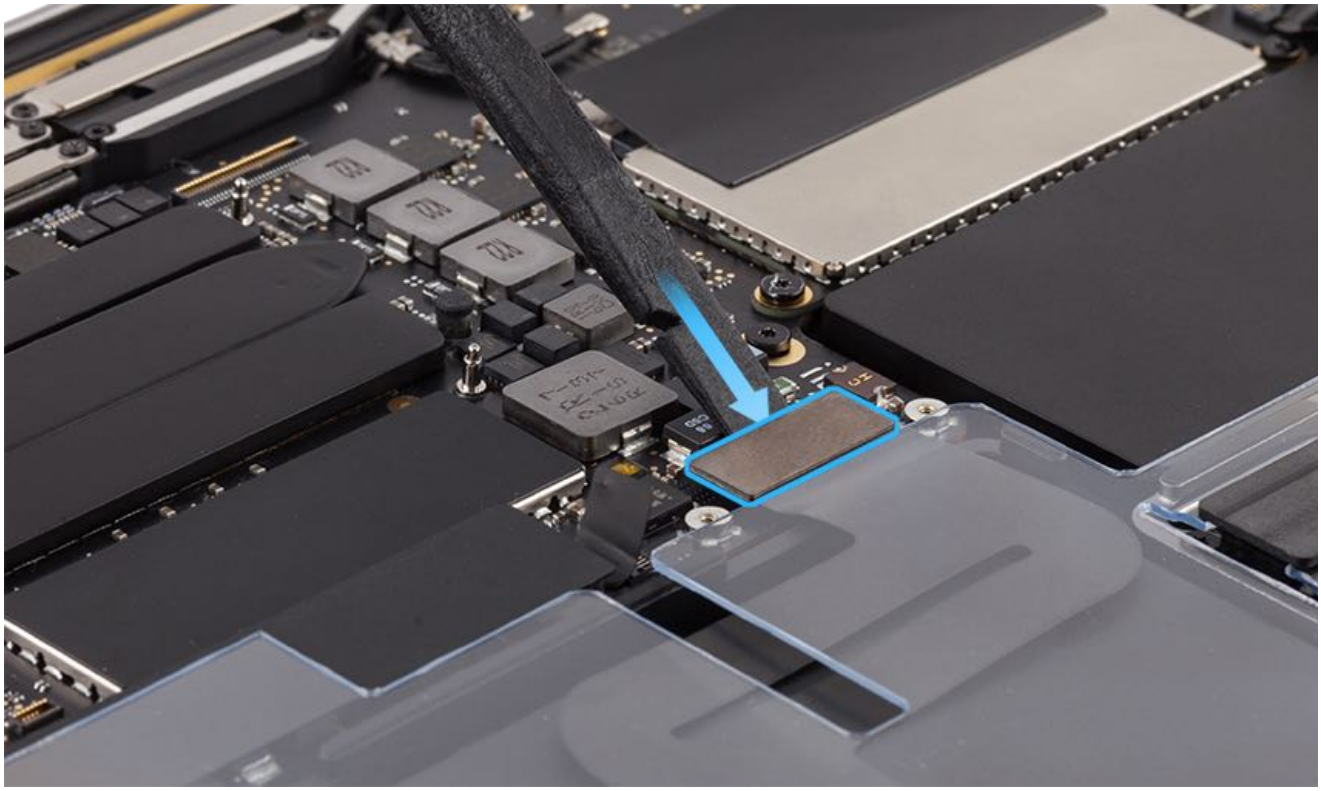
- Antenna tool (923-01322), optional
- Black stick
- ESD-safe plastic or nylon tweezers
- Torx T5 screwdriver (magnetized)
- Battery cover (923-01318)

Steps For Removal

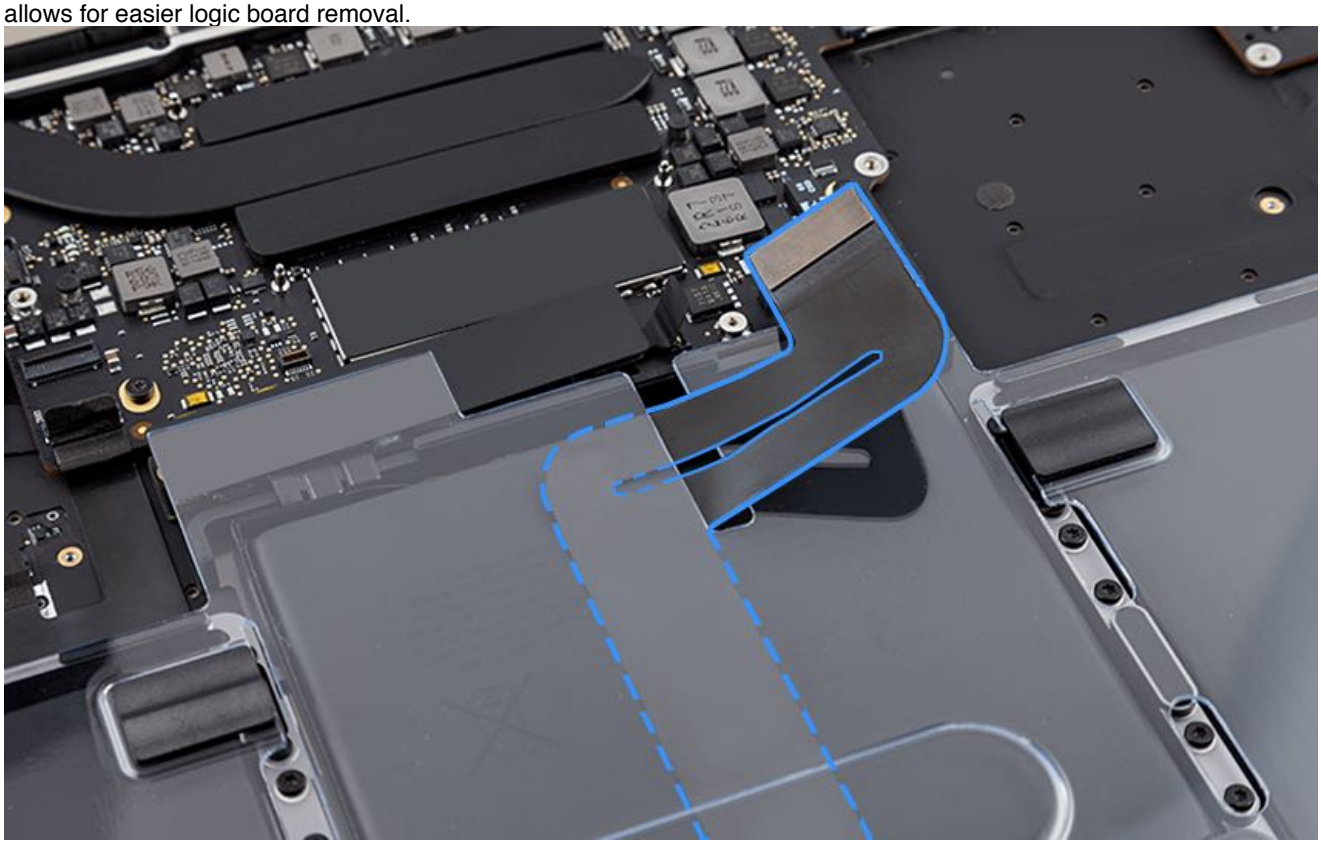
1. With the battery cover installed and the battery cable already disconnected, remove two T5 trackpad cable cowling screws (923-01281).



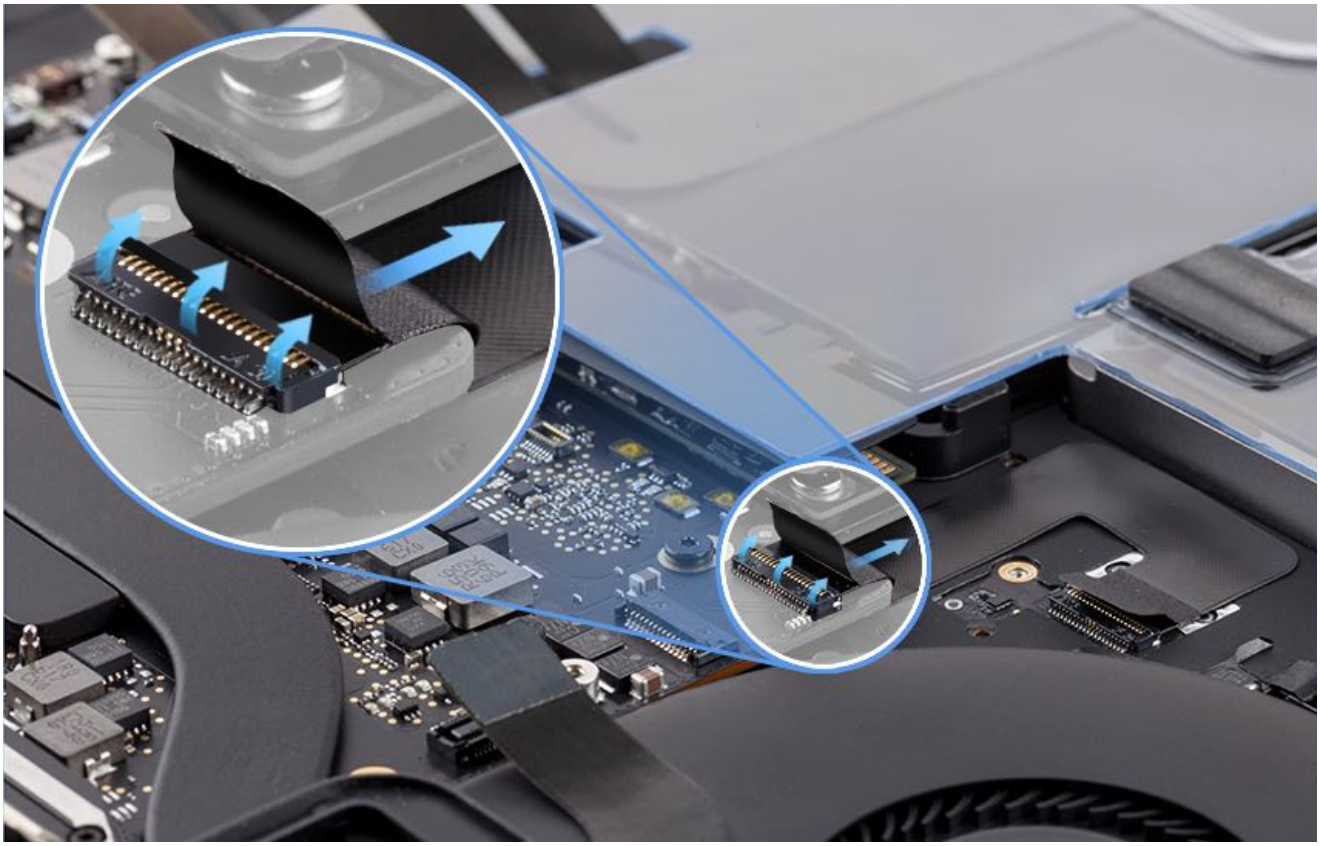
2. Use the flat end of a black stick to disconnect the trackpad flex cable from the logic board connector.



3. Remove and reinstall the battery cover so the trackpad flex cable rests on top of the battery cover (as shown). This allows for easier logic board removal.



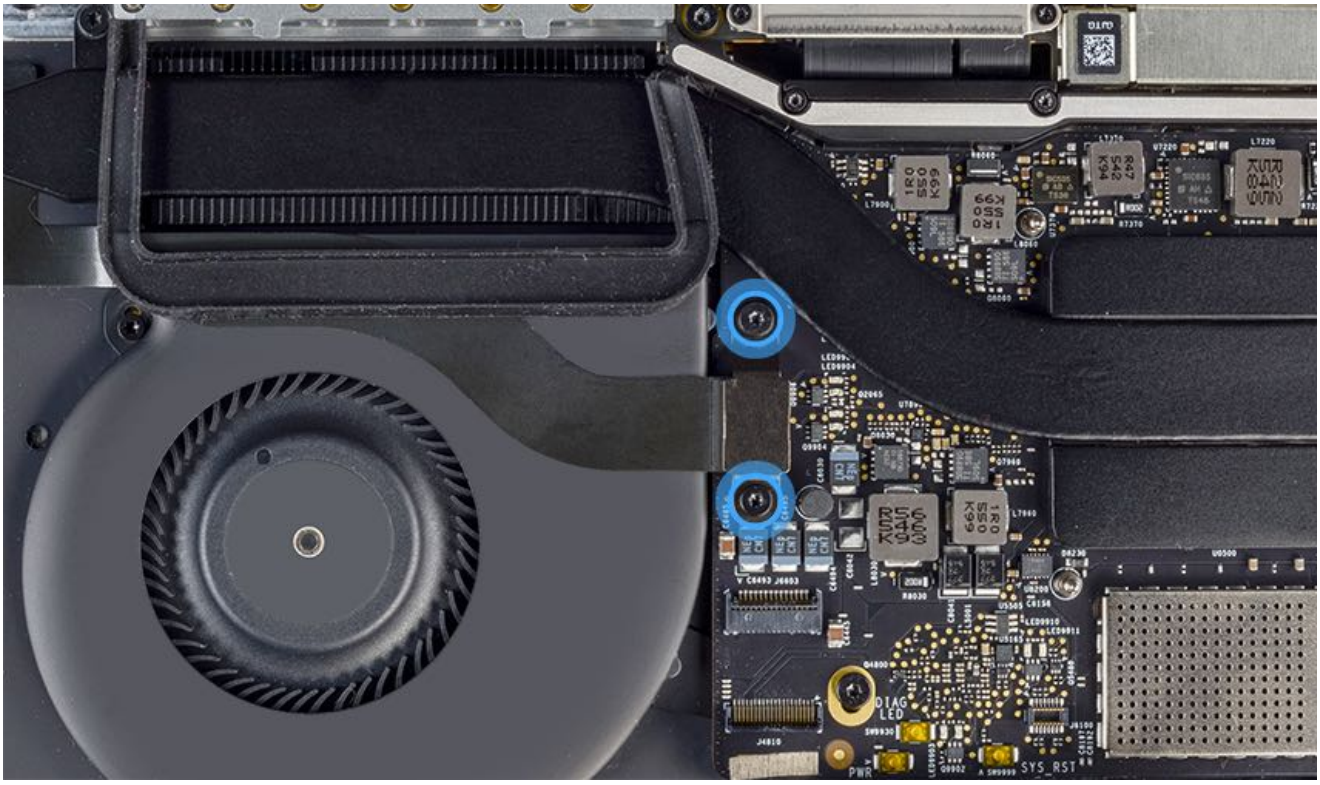
4. Rotate the computer counter-clockwise to view the keyboard flex cable connector on the logic board. Use the flat end of a black stick to lift the tab covering the locking lever. Use the flat end of the black stick to lift the locking lever on the logic board connector. Gently ease the keyboard flex cable from the connector using your fingers and the black stick.



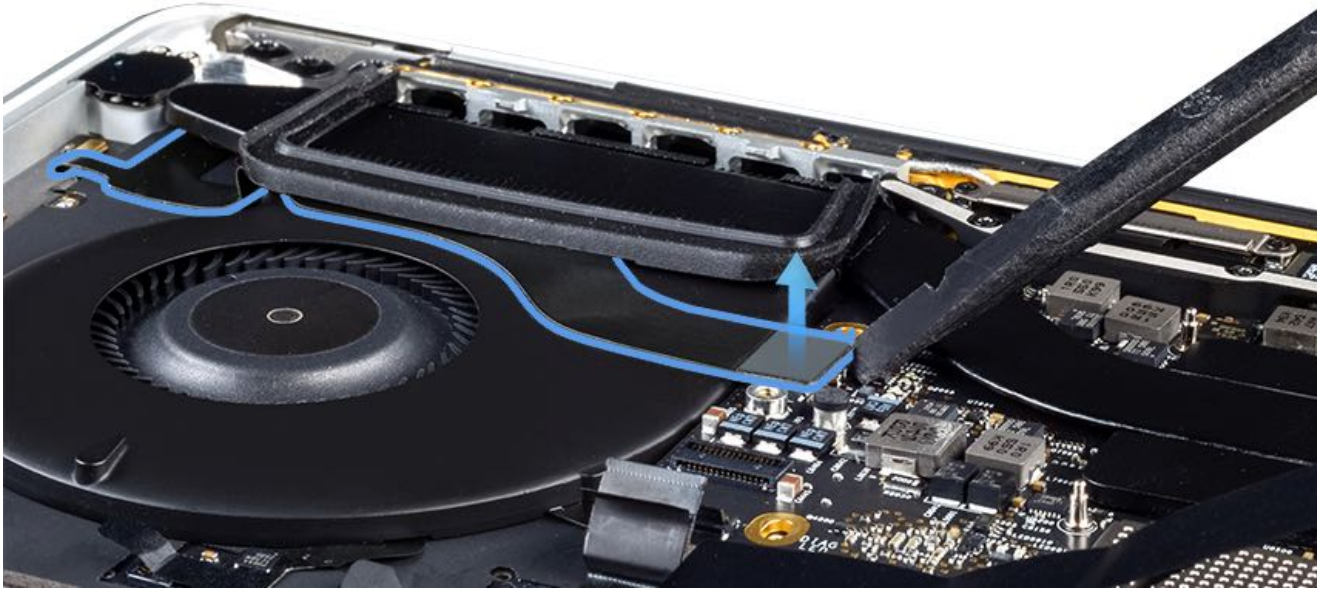
5. Rotate the computer clockwise so the display hinge is at the top. Remove two T5 audio cable cowling screws. **Note:** The upper cowling screw is longer.

923-01277

923-01177

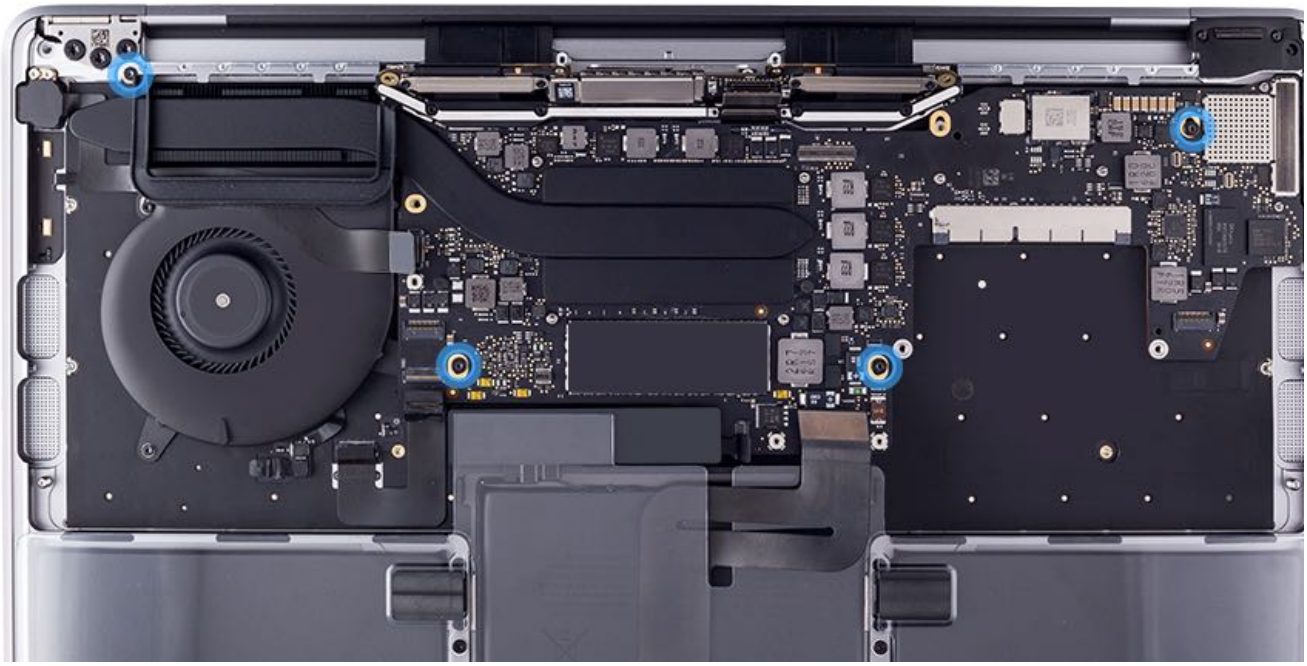


6. Use the flat end of a black stick to disconnect the audio flex cable from the platform connector on the logic board. **Note:** The audio flex cable is part of the top case.

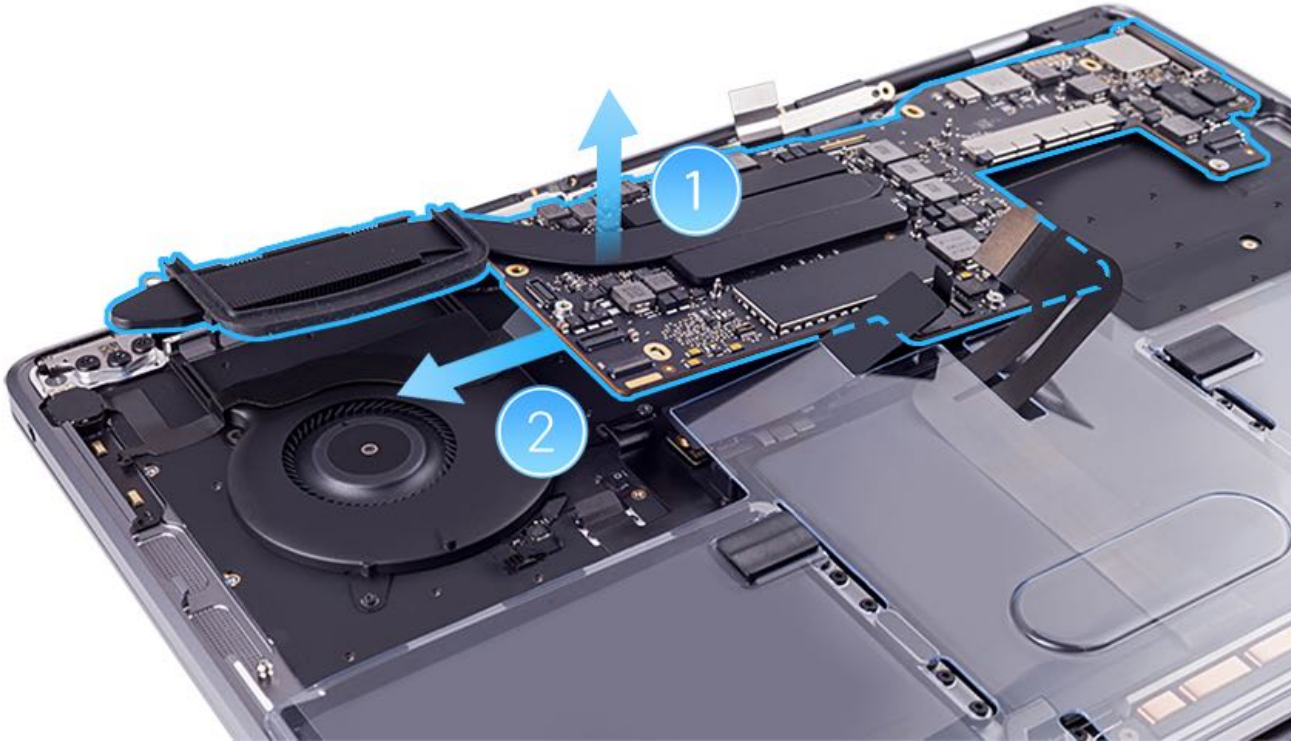


7. Remove four T5 logic board screws. **Note:** The screw in the top left corner is shorter.
923-01176

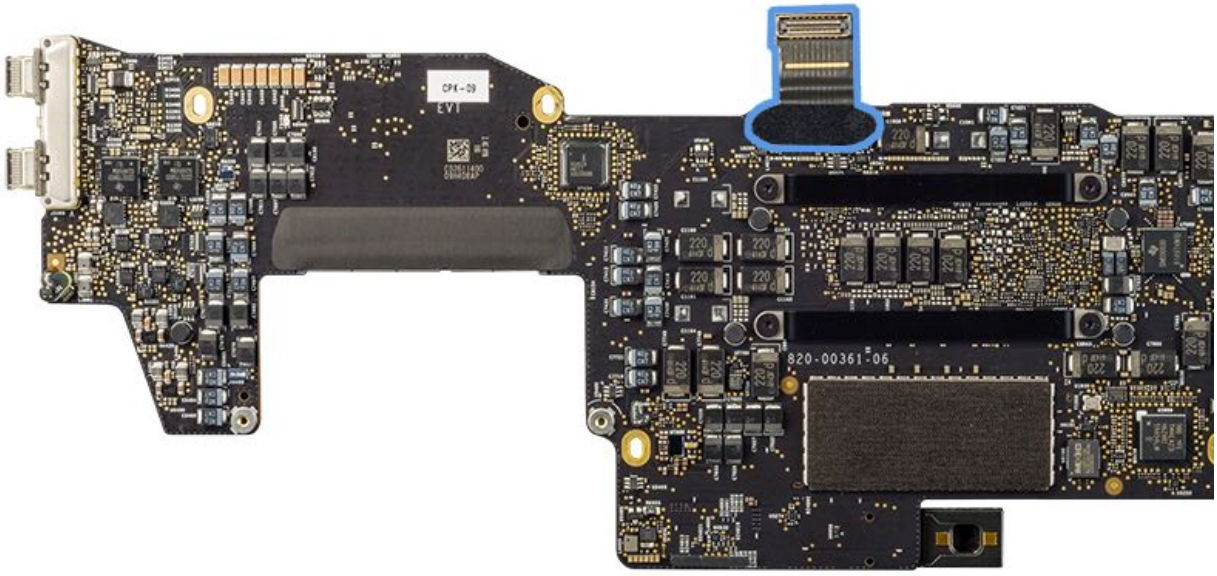
923-01180



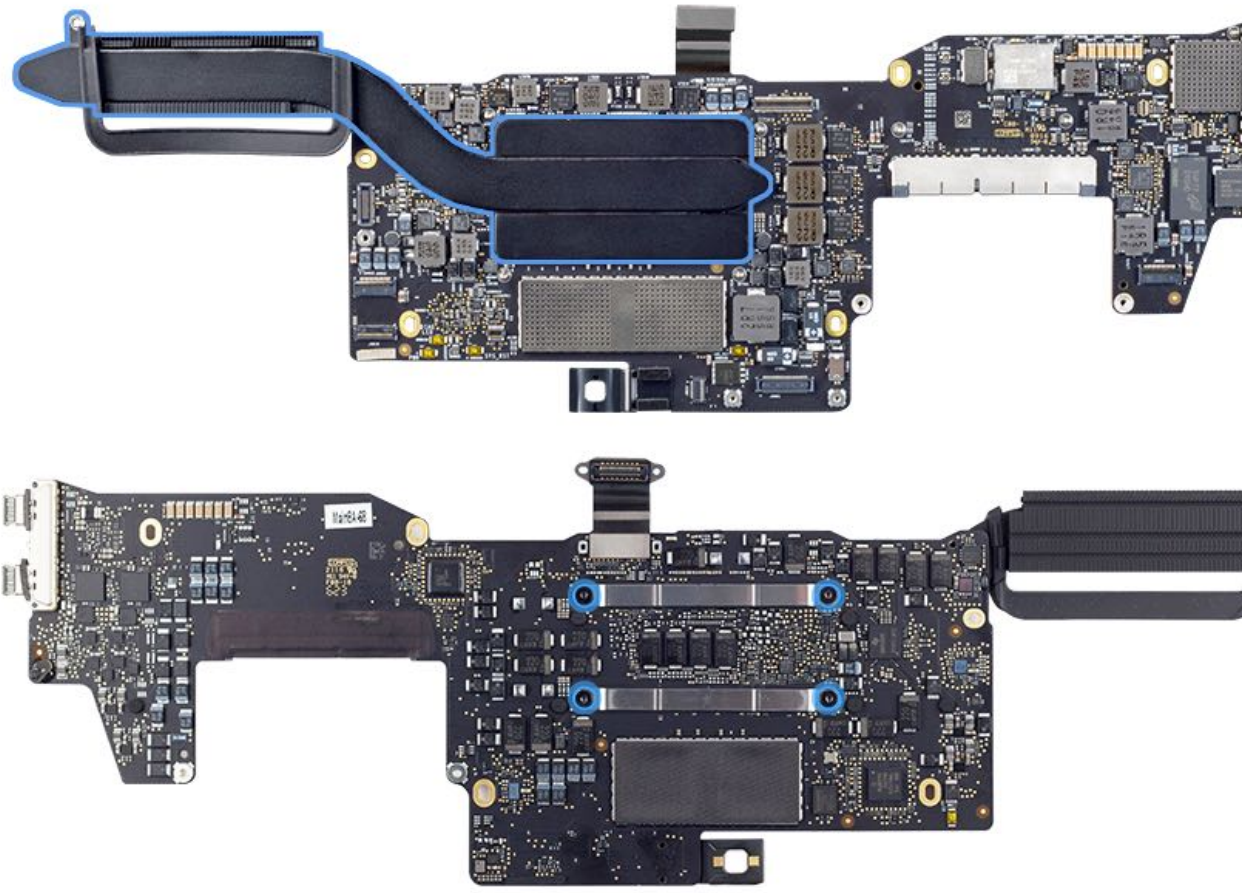
8. Move the flex cables out of the way, lift the logic board (1) at a 15-degree angle, then carefully remove the board (2) from the top case. Be careful not to damage the two Thunderbolt 3 (USB-C) connectors and components on the underside of the board.



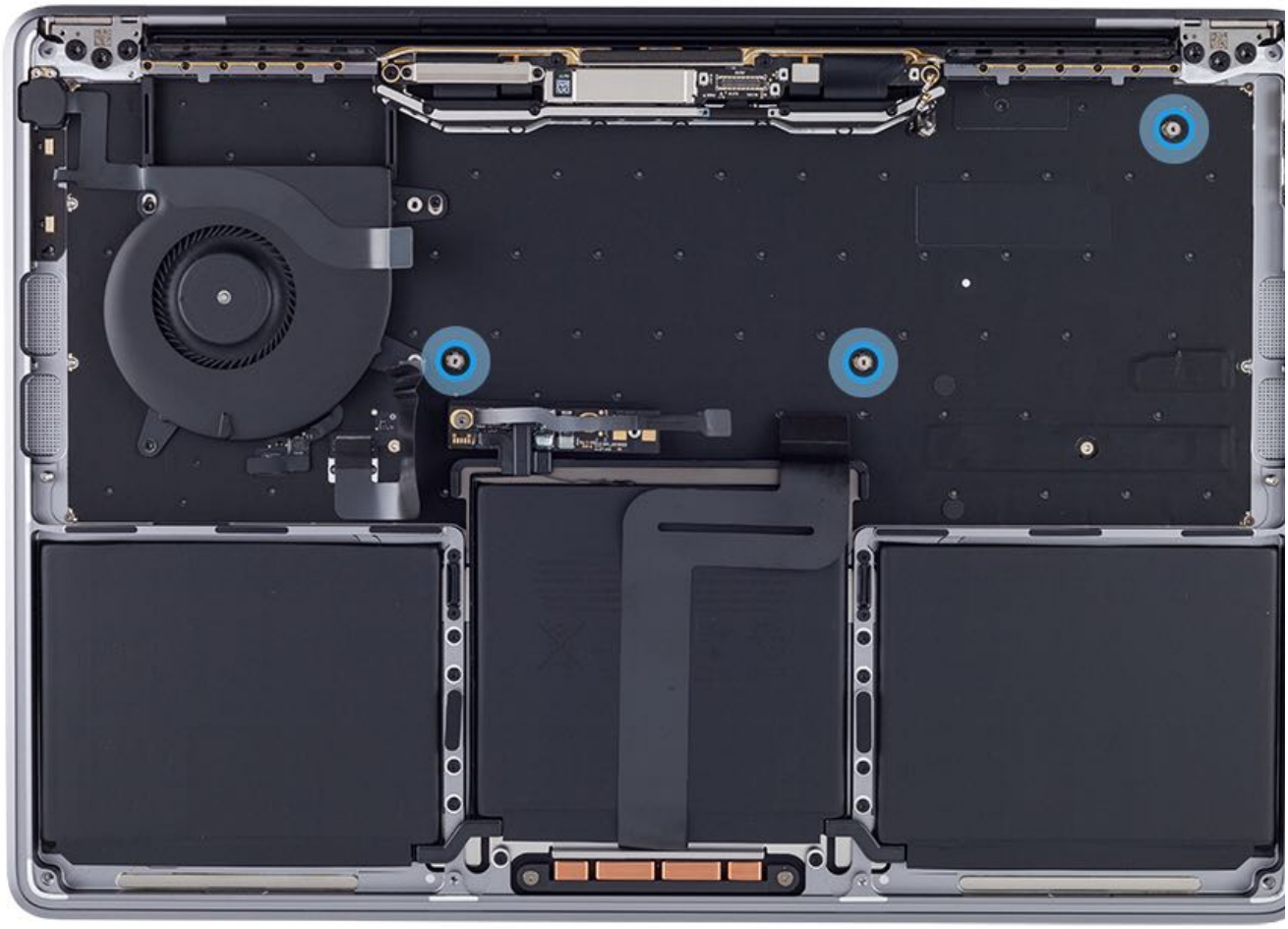
9. If replacing the logic board, remove and transfer the following to the replacement logic board:
    - Embedded display port (eDP) cable, two T4 screws and Mylar tape.



- Heat sink and four T5 screws, 452-00956. Refer to article RP1325: Heat Sink.

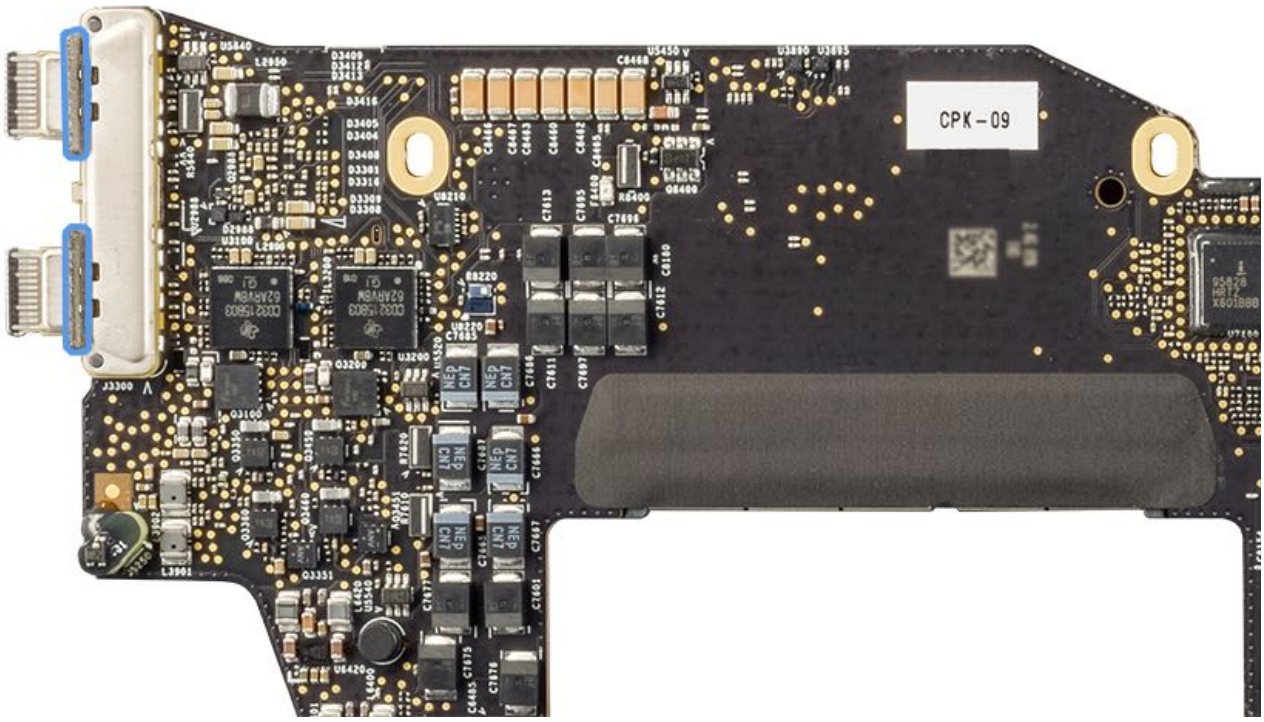


10. Place the known-bad board in the logic board holder (923-01130) and return it to Apple Service.
11. Inspect the top case to make sure that the logic board standoffs are present. If they are not, order replacement standoffs (923-01874.)
12. Inspect the logic board standoff for any damage. If there's no standoff damage and the blue strip of Nylok® on the standoff is still intact, then reinstall the standoff in the top case before installing the logic board.
13. Inspect logic board screw for any damage and make sure the blue strip of Nylok® is intact before installing screw.

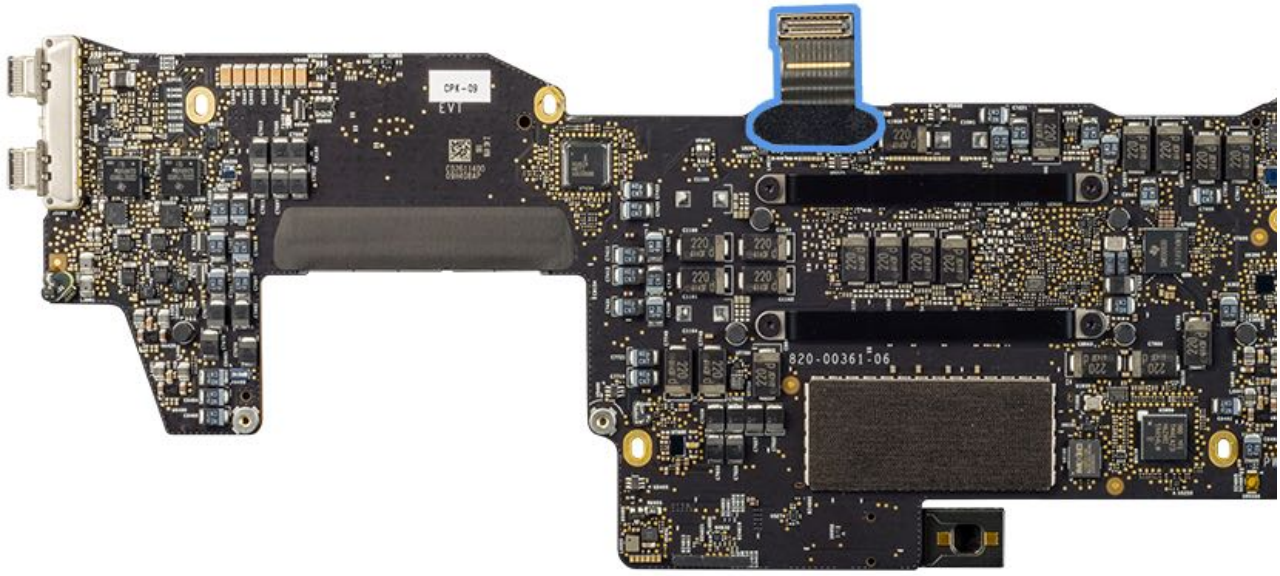


Steps For Reassembly

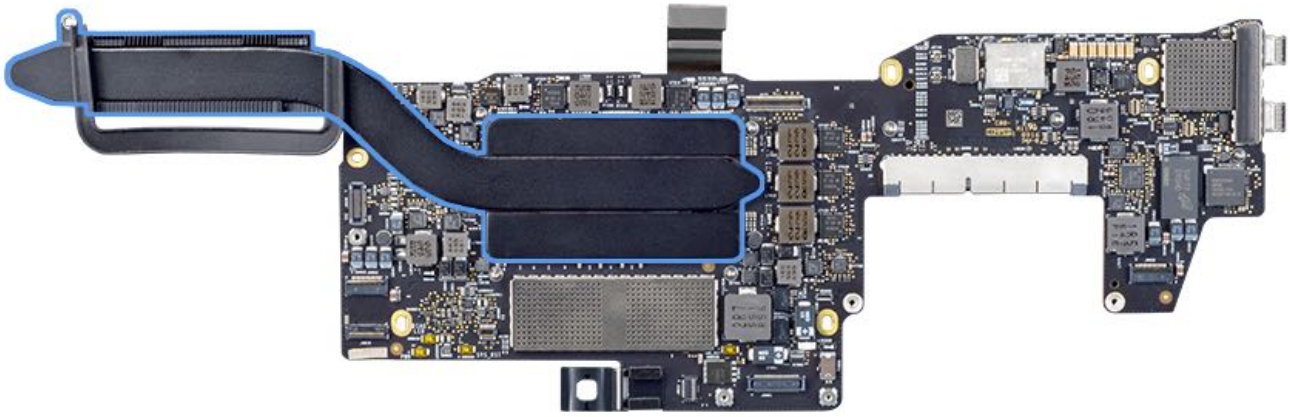
1. Check that the foam gaskets (shown below) are present on the Thunderbolt 3 connectors. If a gasket is missing, order part number 923-01172.



2. Check that the eDP flex cable is attached to the logic board.

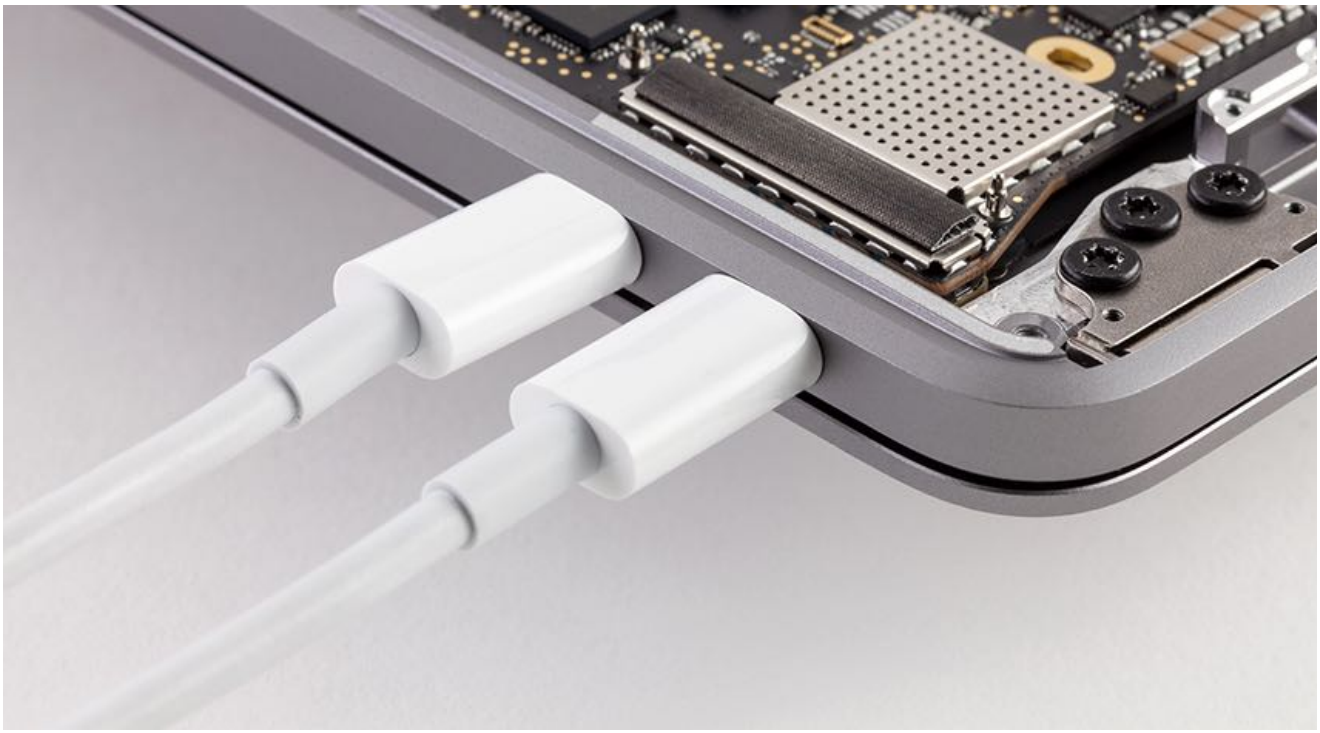


3. Check that the heat sink is installed.

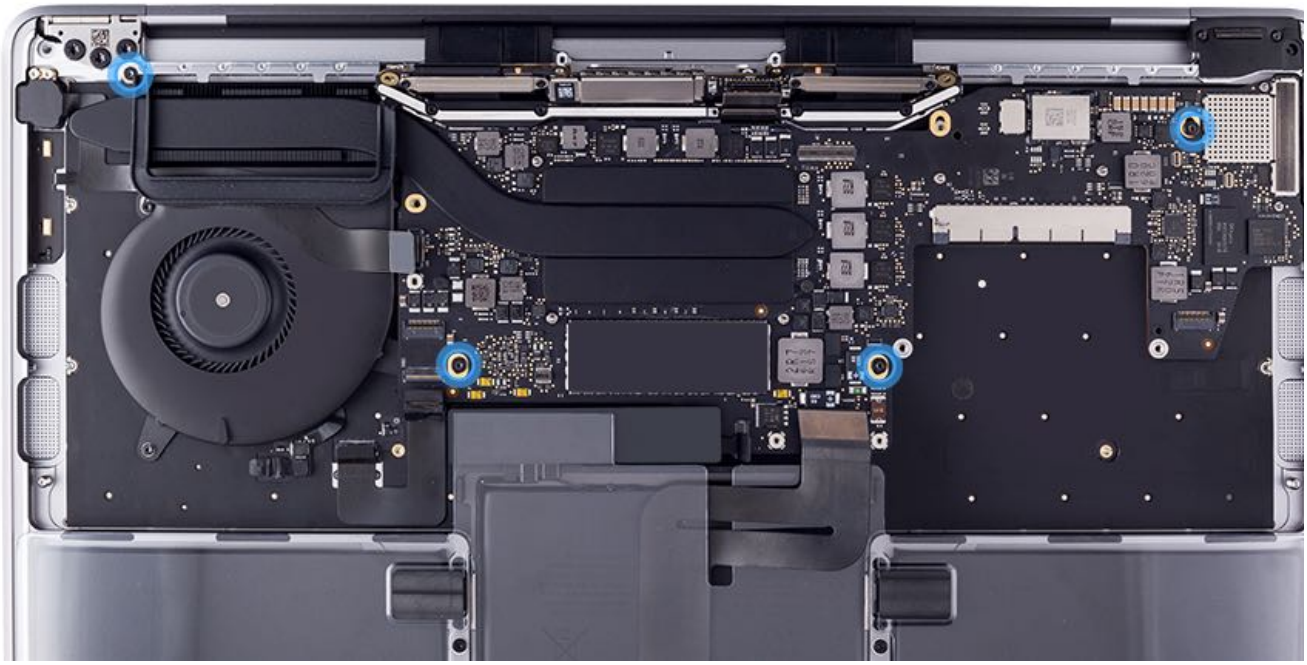


4. Check that the thermal duct is wrapped around the heat sink.

5. Reinstall the logic board into the top case, aligning the two Thunderbolt 3 ports with the openings in the top case.
6. After placing the logic board into position in the top case, plug in an external USB-C charge cable to both Thunderbolt 3 ports.
   Warning: The charge cable should NOT be plugged into power.
   Keeping the cable connected, check that the screw holes in the logic board align with the screw standoffs in the top case.

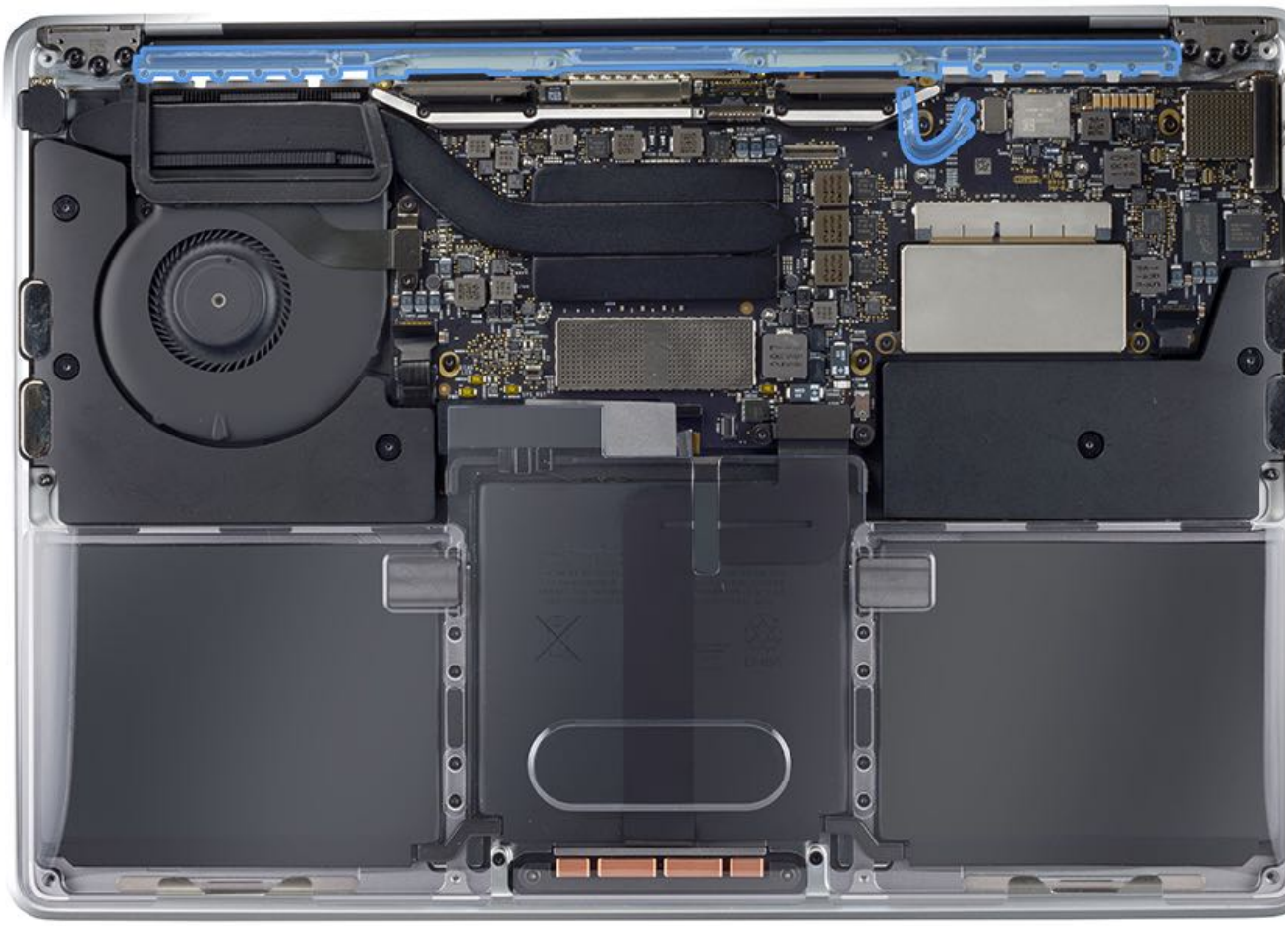


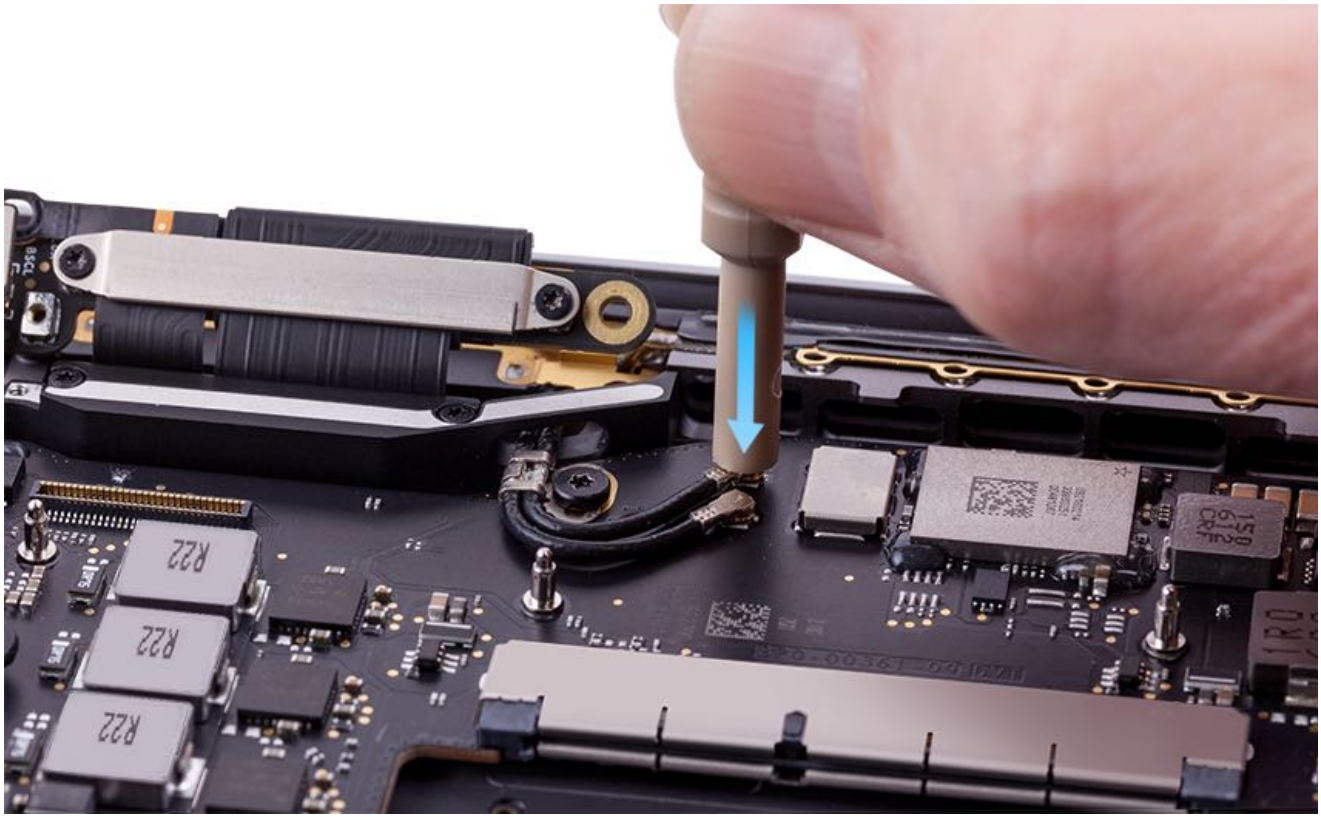
7. Lightly press on the opposite edge of the board to hold it in place while reinstalling the four T5 logic board screws.
   Note: The short screw attaches in the top left corner above the fan.



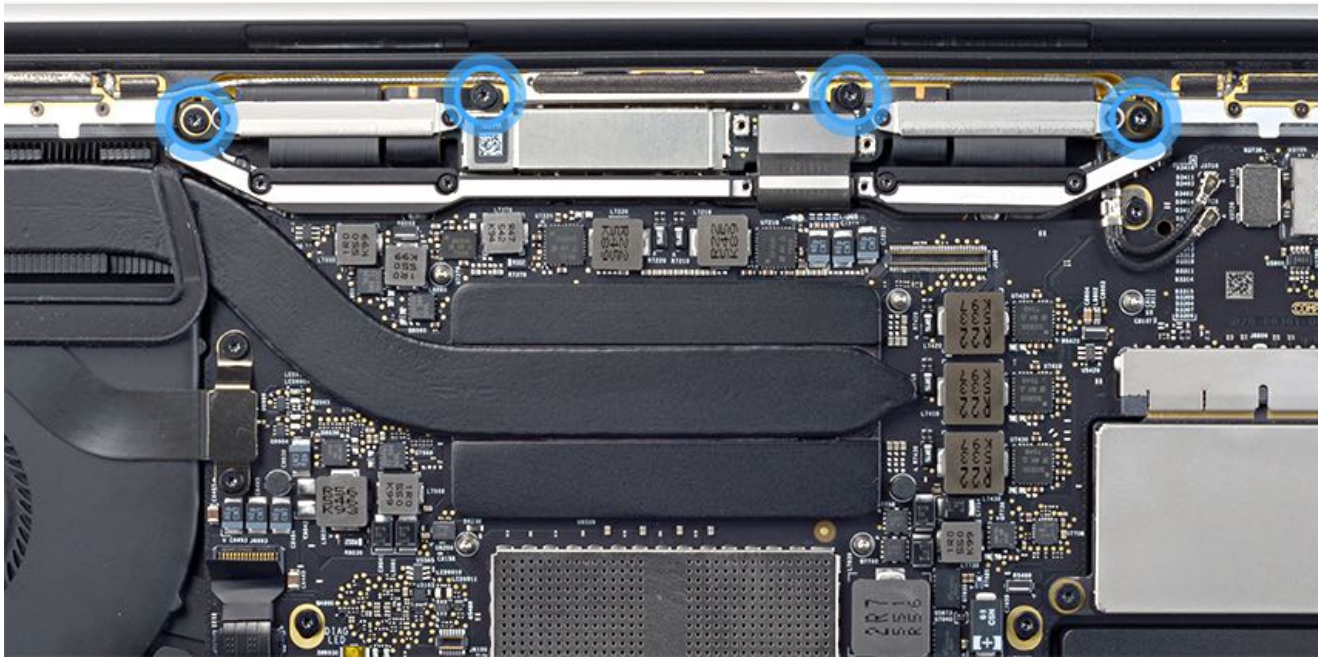
8. Unplug the USB-C charge cable.

9. Reinstall the vent/antenna module by gently pressing the middle to seat the module into the top case. Then do the following:
   - Reinstall twelve IPR vent/antenna screws. Turn each screw until the torque driver clicks.
   - Reinstall the T5 antenna screw at the grounding clip.
   - Reconnect the two antennas using a tweezers or the antenna tool.

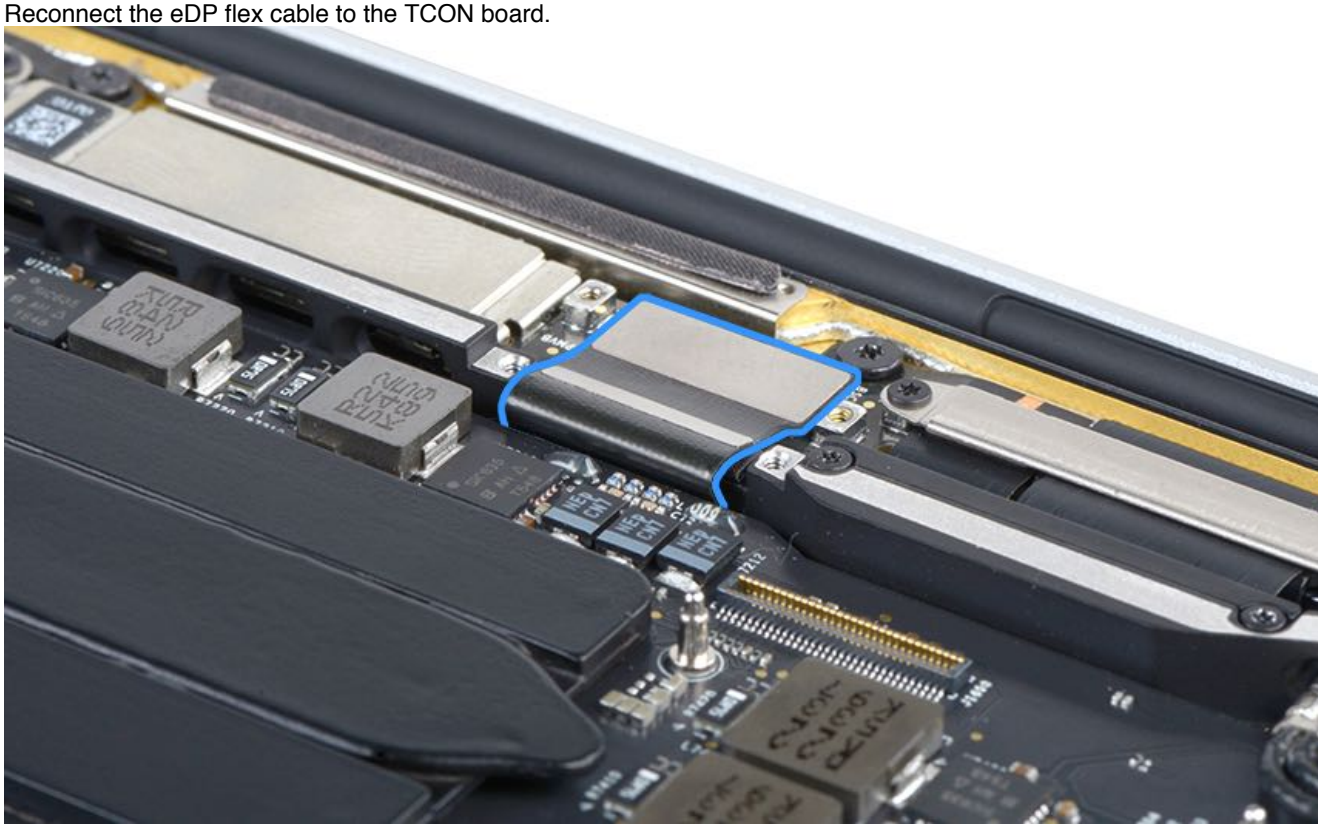




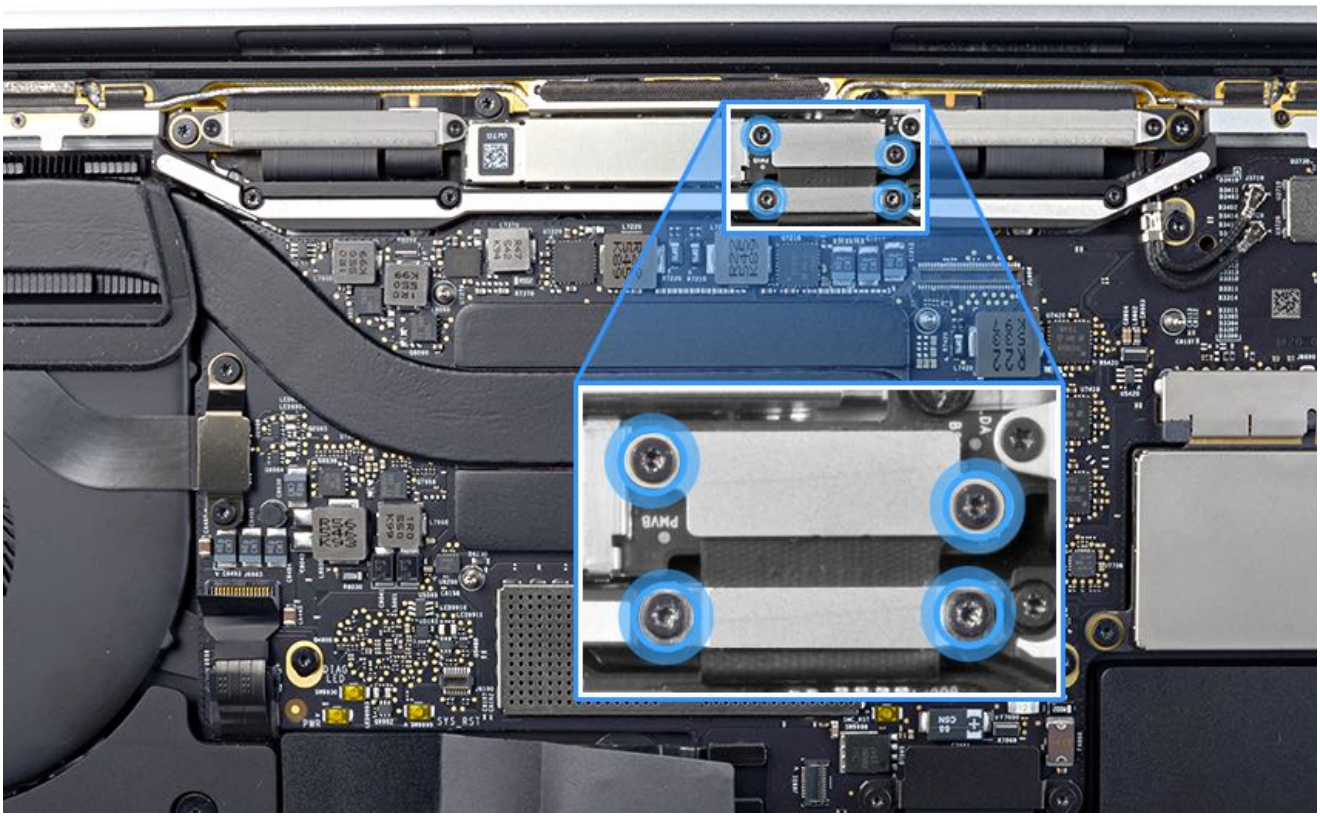
10. Reinstall the four T5 TCON board screws. **Note:** The shoulder screws are the two outer screws.



11. Reconnect the eDP flex cable to the TCON board.

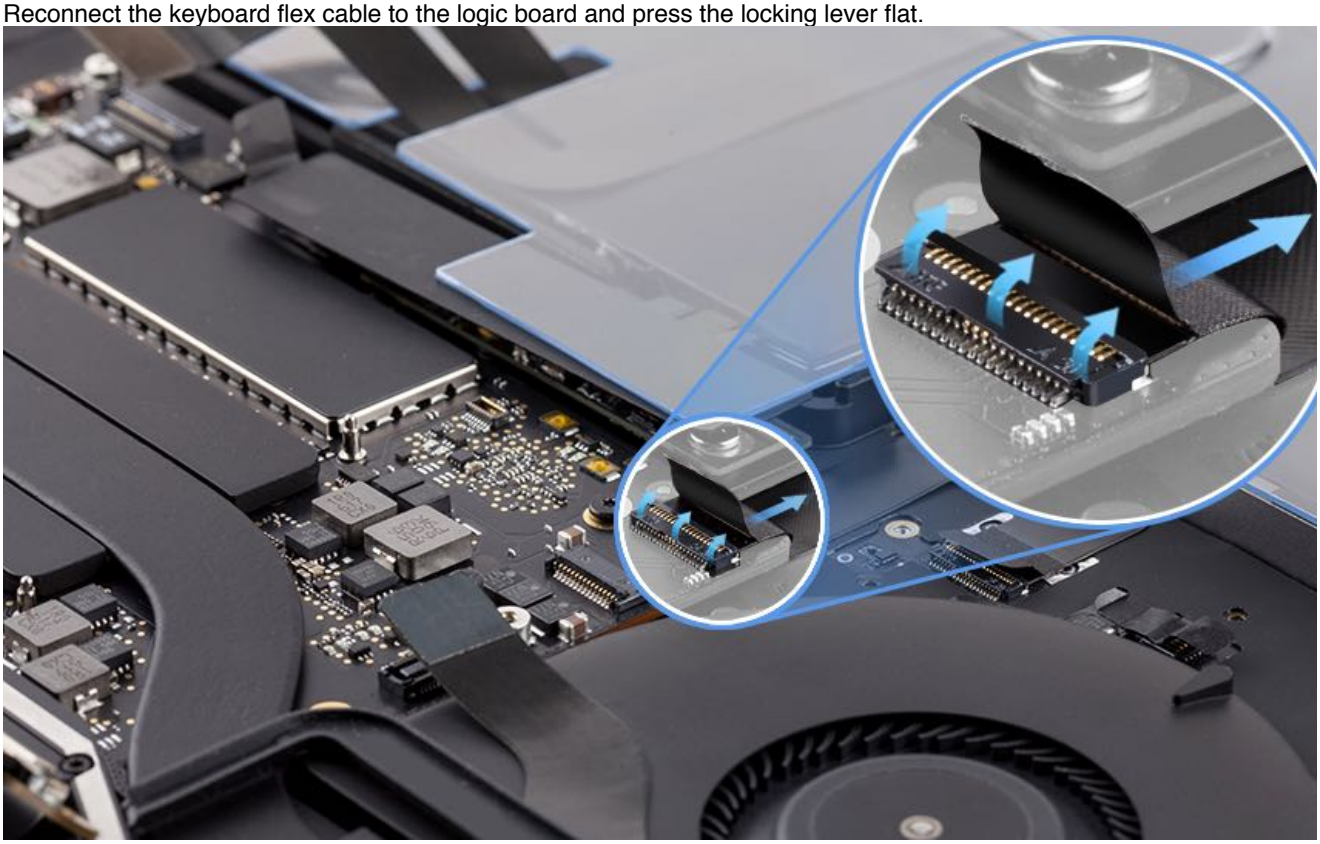


12. Reinstall the two eDP flex cable cowlings and four T3 cowling screws. Make sure the gasket on the lower cowling makes contact with the eDP cable. **Note:** The upper cowling uses the shorter screws.

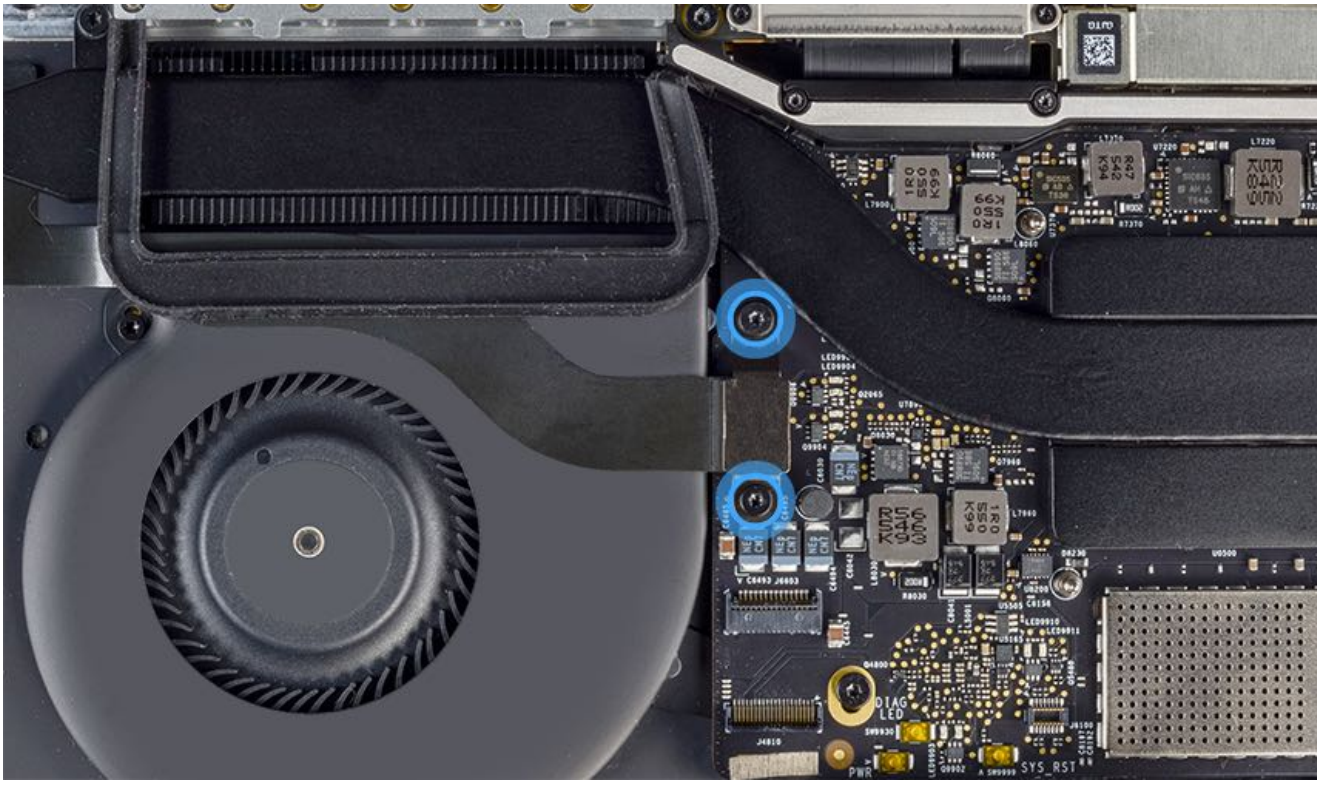


13. Reinstall the clutch covers.

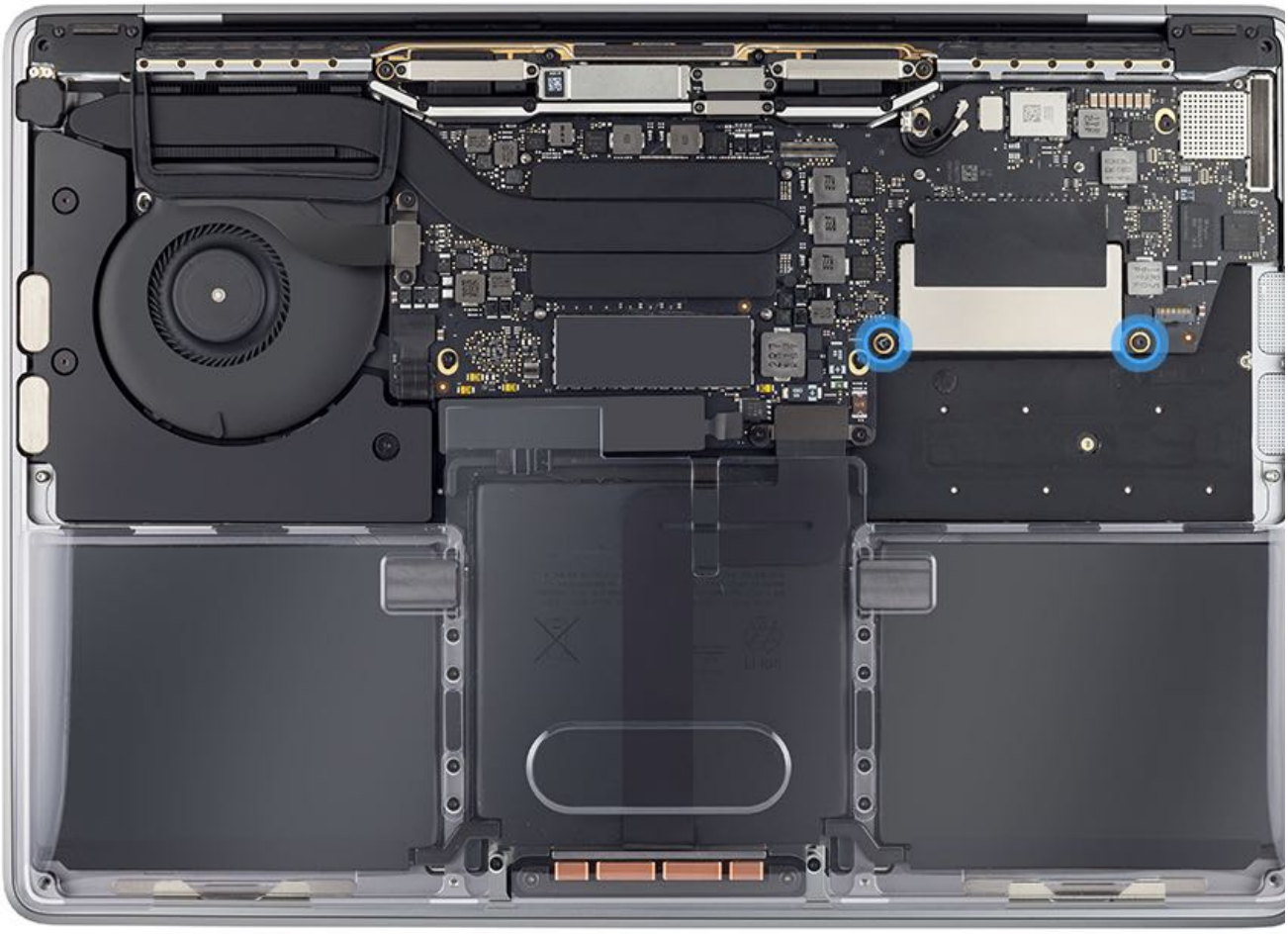
14. Reconnect the keyboard flex cable to the logic board and press the locking lever flat.



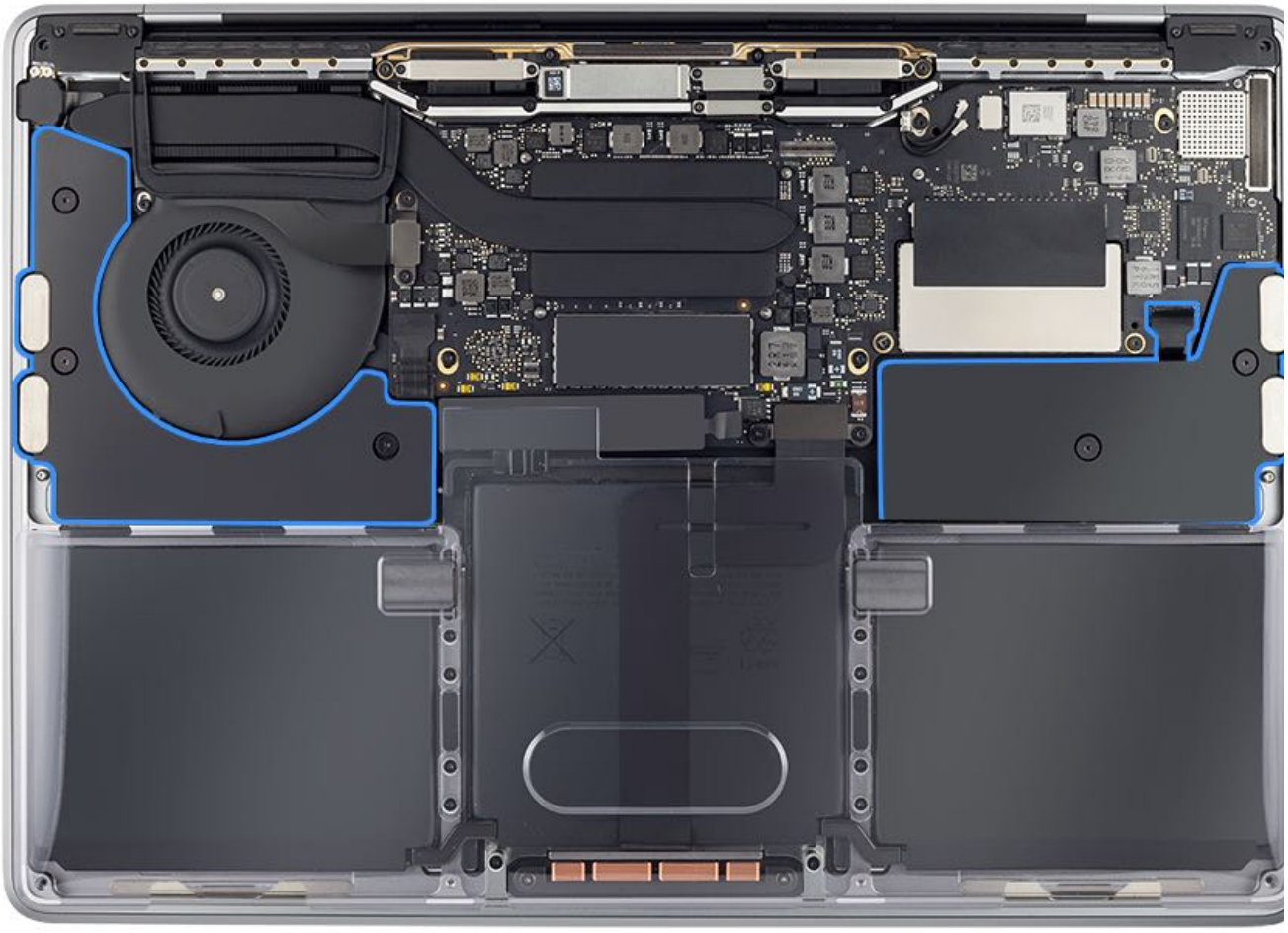
15. Reconnect the audio cable, reinstall the cowling, and two T5 screws. **Note:** The upper cowling screw is longer.



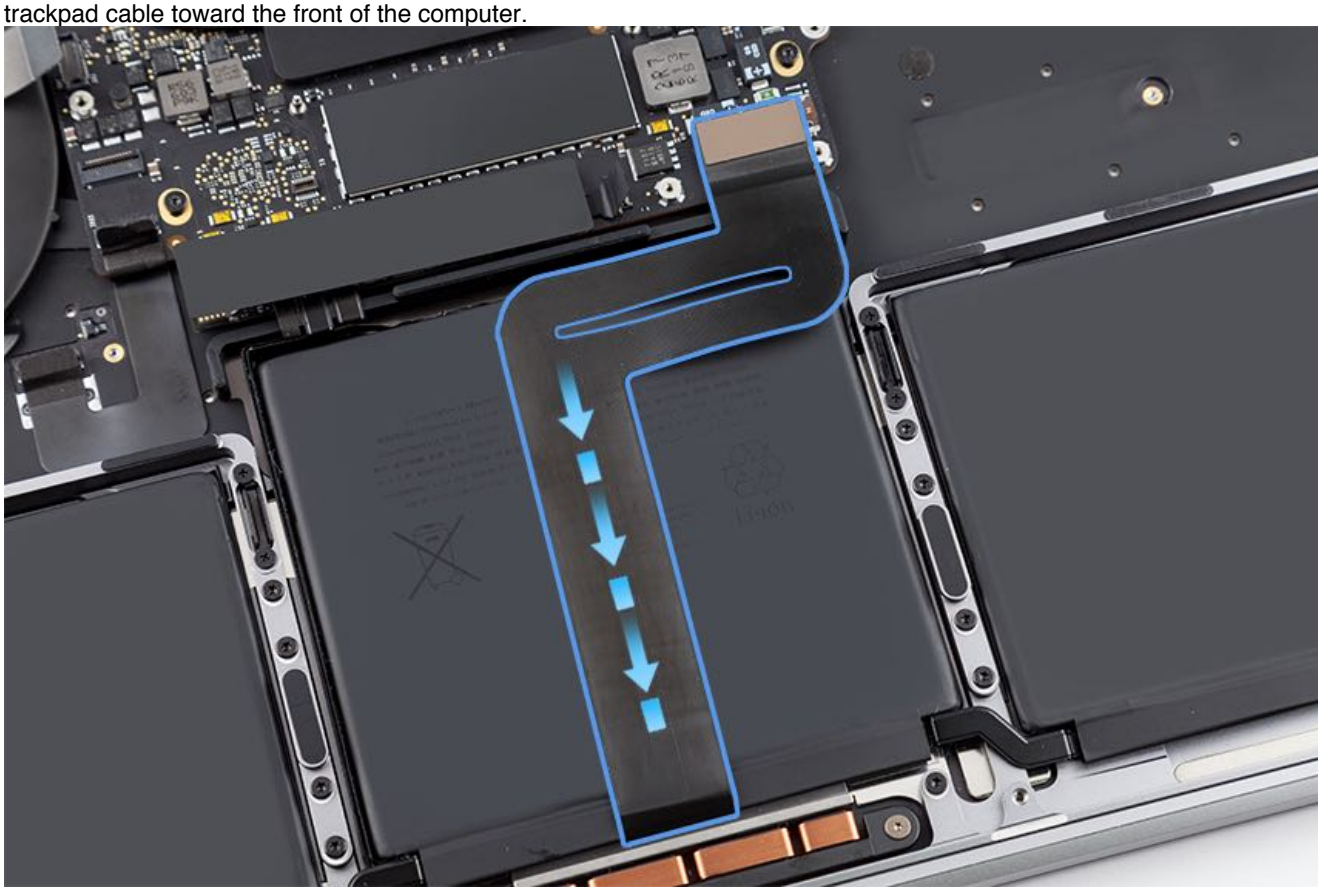
16. Reinstall the flash storage card if removed previously. Reinstall two T5 flash storage card screws, and adhere a new strip of shield tape over the connector. Refer to article RP1287: Flash Storage.



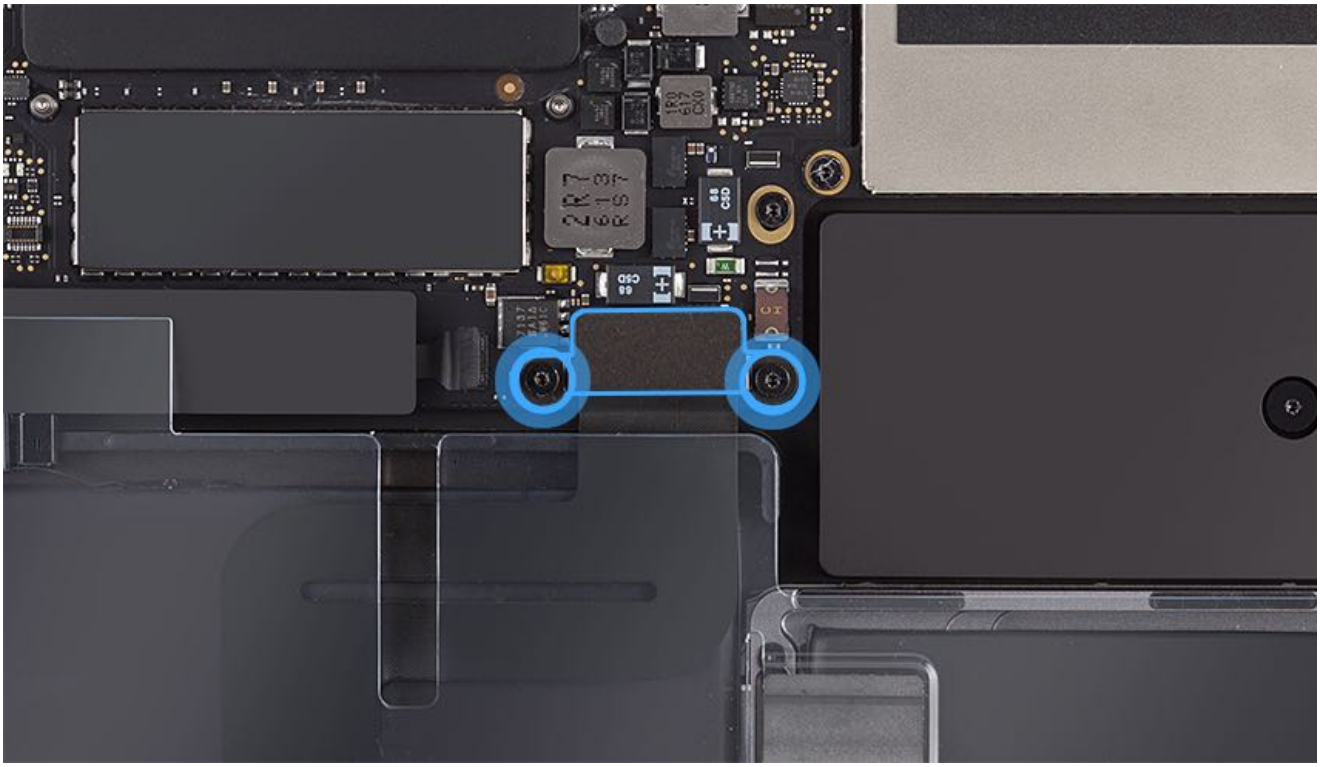
17. Reinstall the speakers if removed previously. Reconnect the flex speaker cables, and replace five T5 speaker screws.
Note: On the right speaker (which is on the left in the image), the longer screw is near the BMU board.



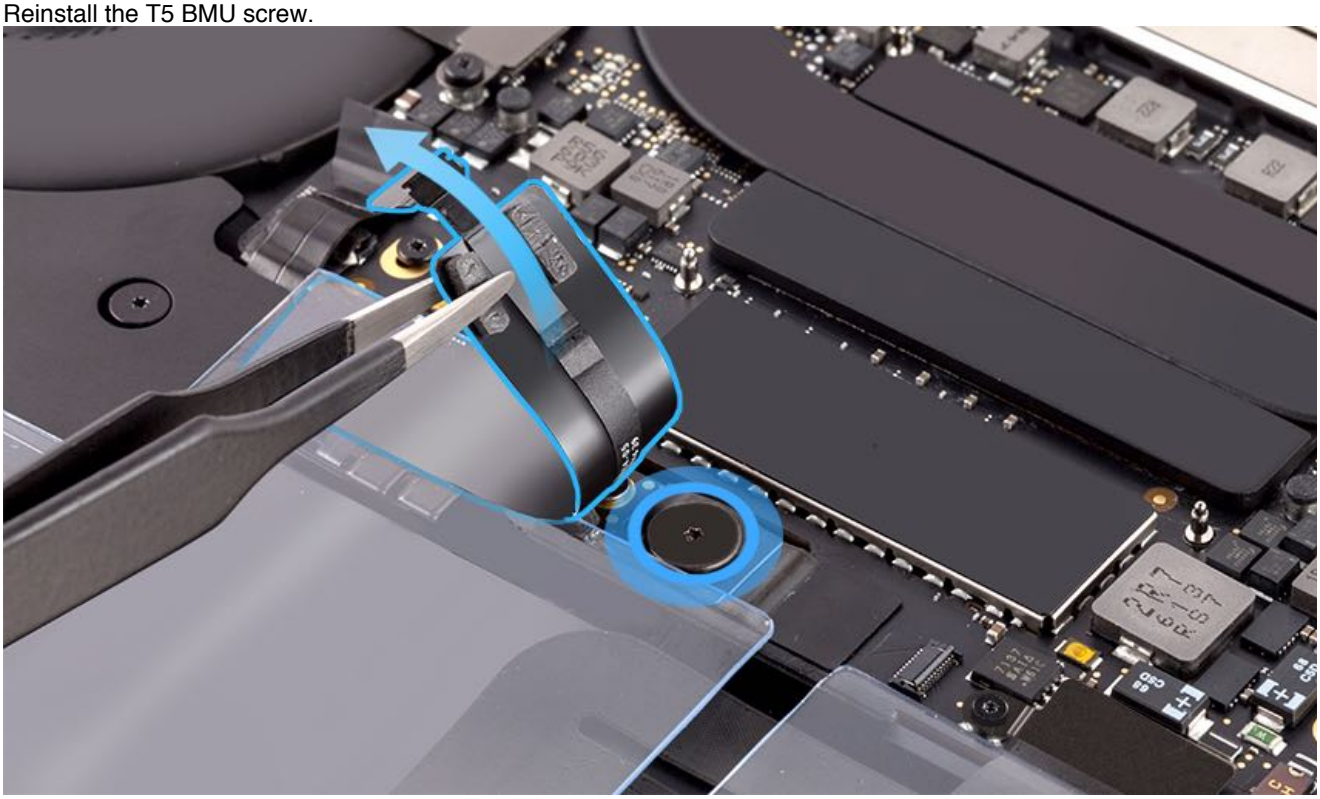
18. Temporarily remove the battery cover. Reconnect the trackpad cable to the logic board. Gently press any slack in the trackpad cable toward the front of the computer.



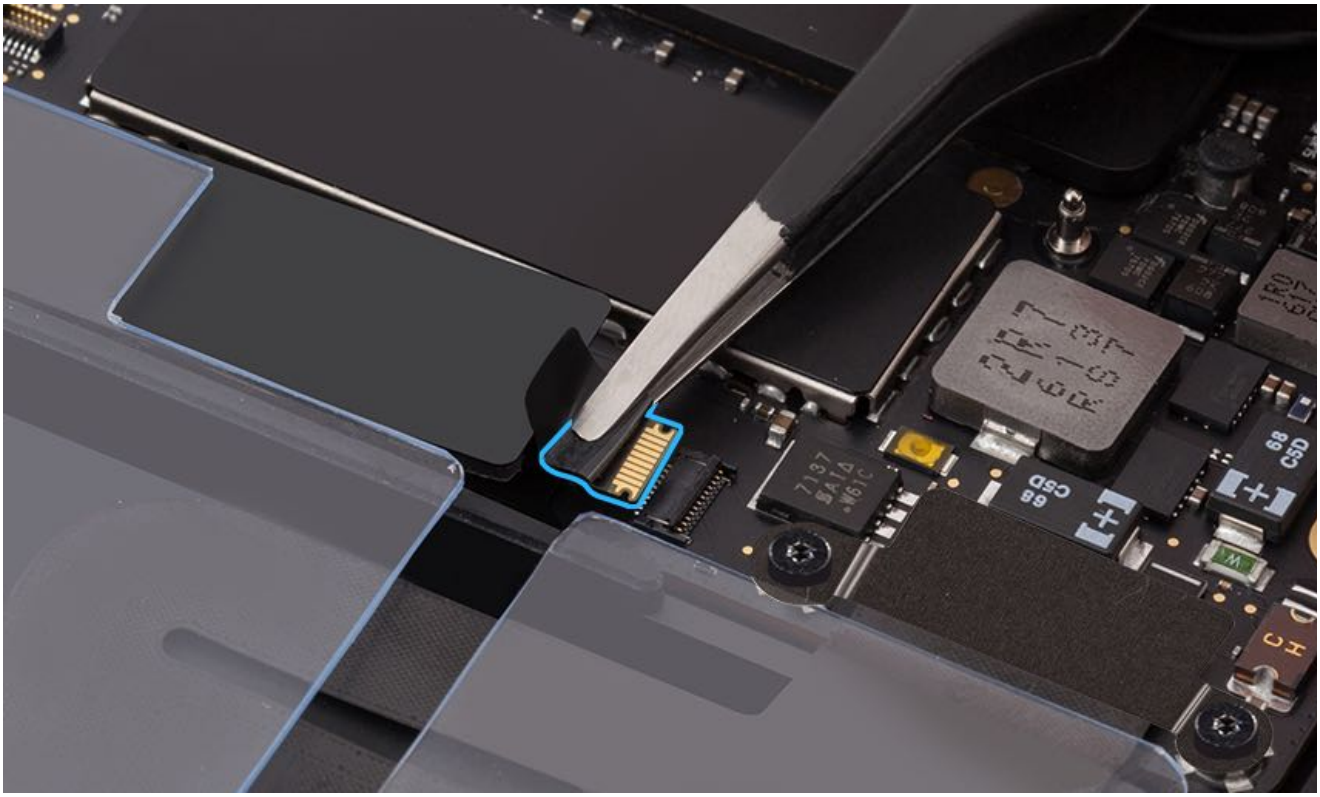
19. Reinstall the battery cover, then reinstall the trackpad cowling and two T5 cowling screws.



20. Reinstall the T5 BMU screw.

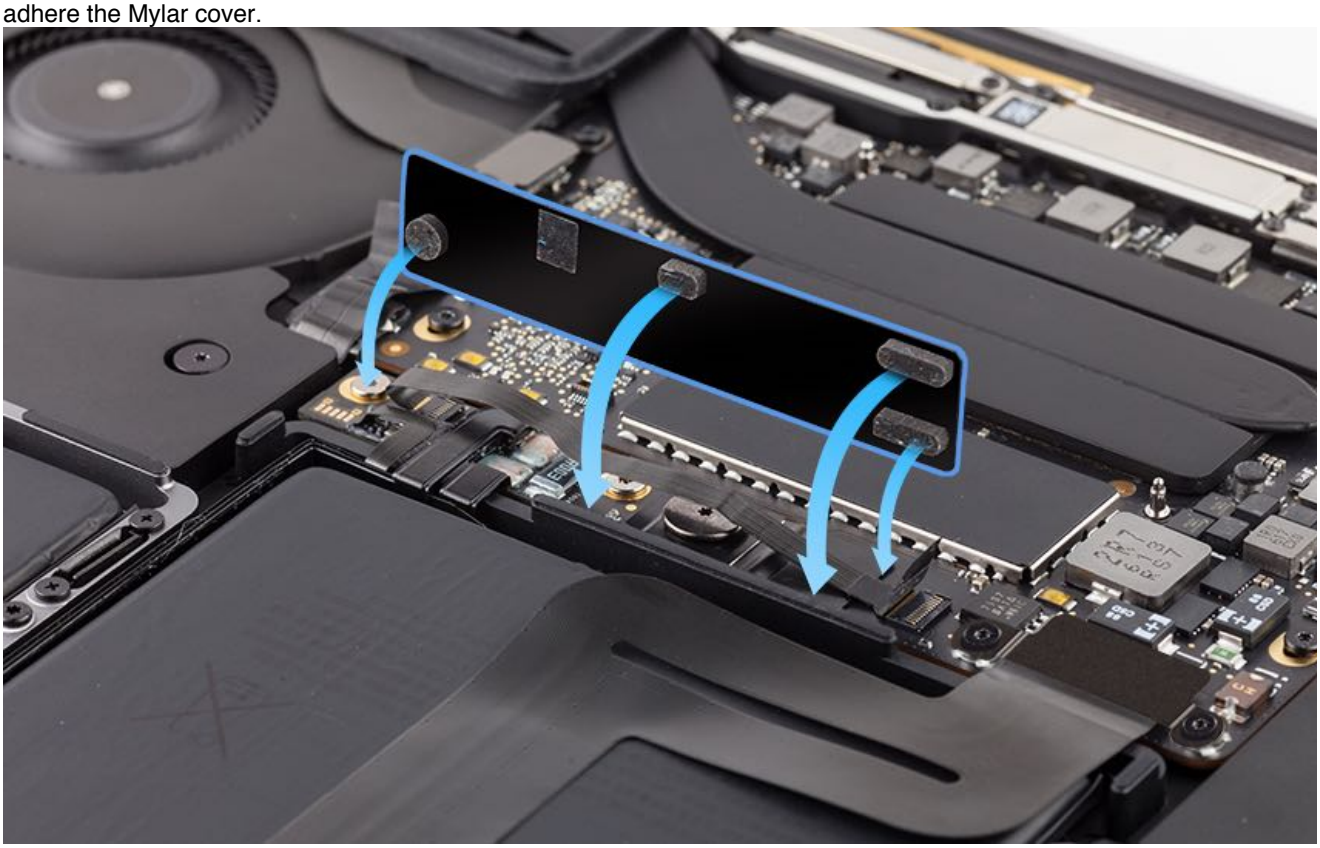


21. Reconnect the battery flex cable to the logic board. Secure the locking lever, pressing it flat.



22. Remove the battery cover.

23. Install a new BMU Mylar cover (included with a replacement logic board) whenever the logic board is removed. **Note:** Before installing the new BMU Mylar cover, check for any residual foam that might be stuck on the BMU board from the original BMU Mylar cover. Use a black stick to remove any residual foam. Remove the adhesive backing from the foam pads on the replacement BMU Mylar cover. Align the Mylar cover with the BMU board as shown. Press gently to adhere the Mylar cover.



24. Reinstall the bottom case.

25. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.

26. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Embedded DisplayPort (eDP) Flex Cable

First Steps

Warning:

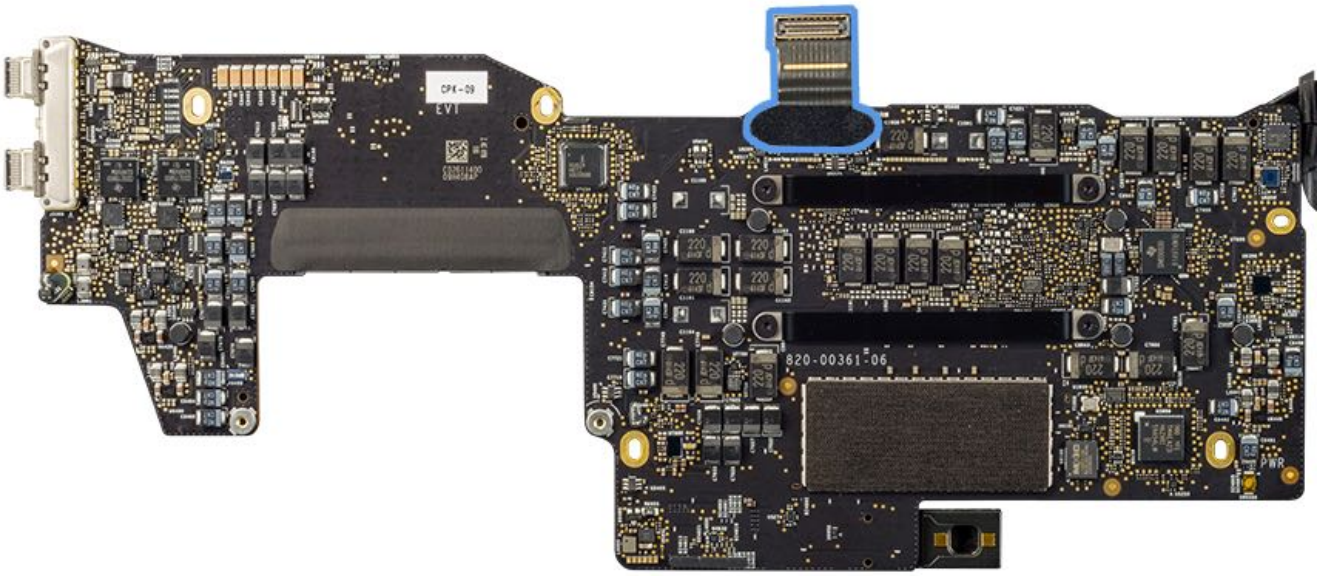
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Clutch covers
- Speakers
- Flash storage
- Embedded DisplayPort (eDP) cowlings
- TCON connector
- Vent/antenna module
- Logic board

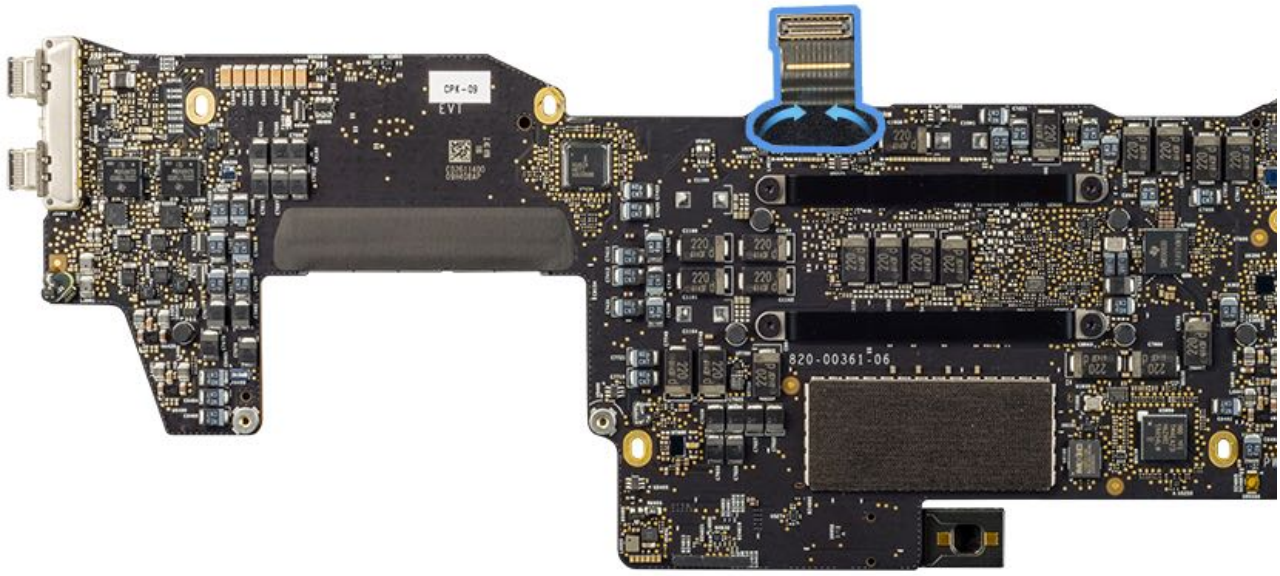


Tools

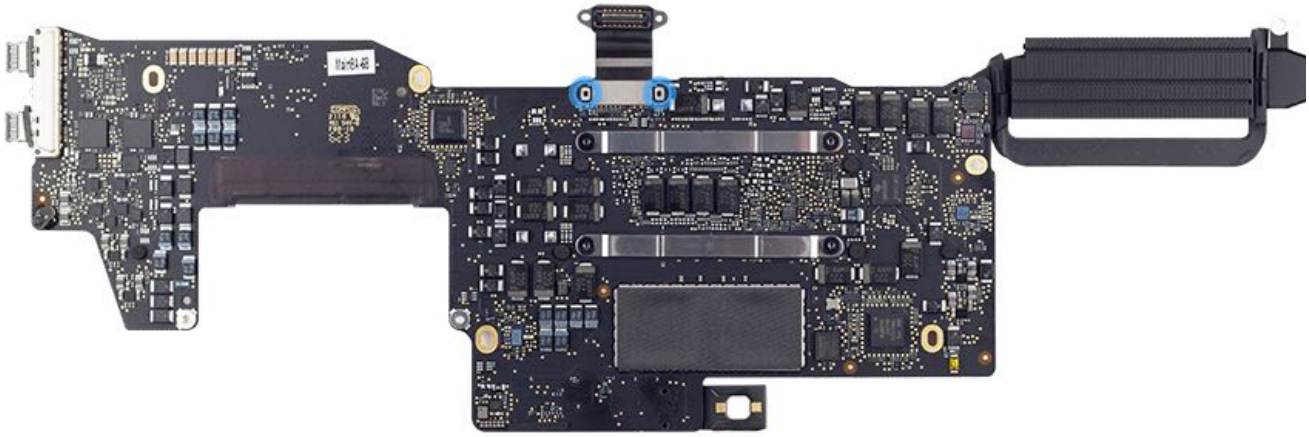
- ESD wrist strap
- Black stick
- Torx T3 screwdriver (magnetized)
- Tweezers

Steps For Removal

1. Peel back the Mylar cowling on the eDP cable to access the eDP screws.

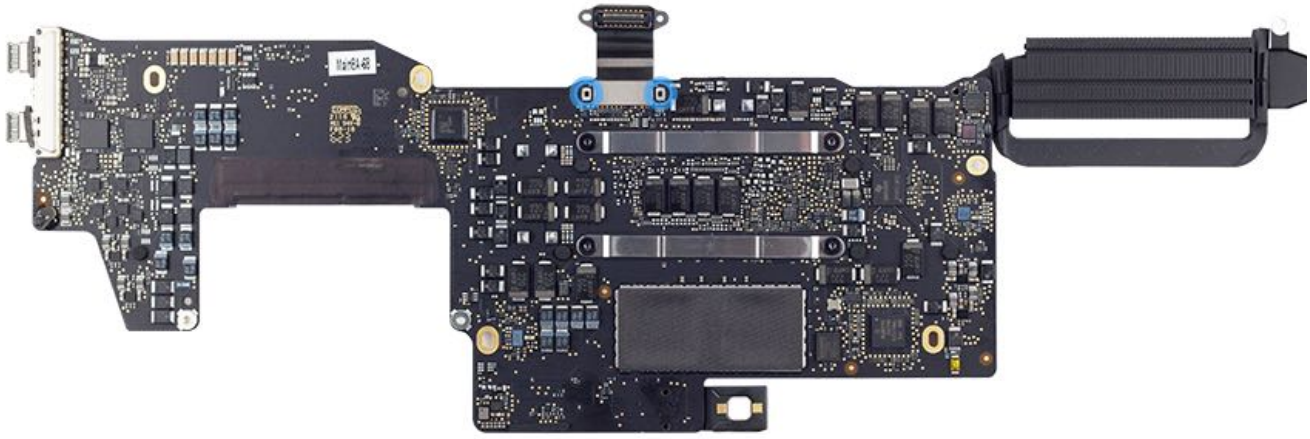


2. Remove two T3 screws (923-01190). Use the flat end of a black stick to remove the eDP cable from the logic board.

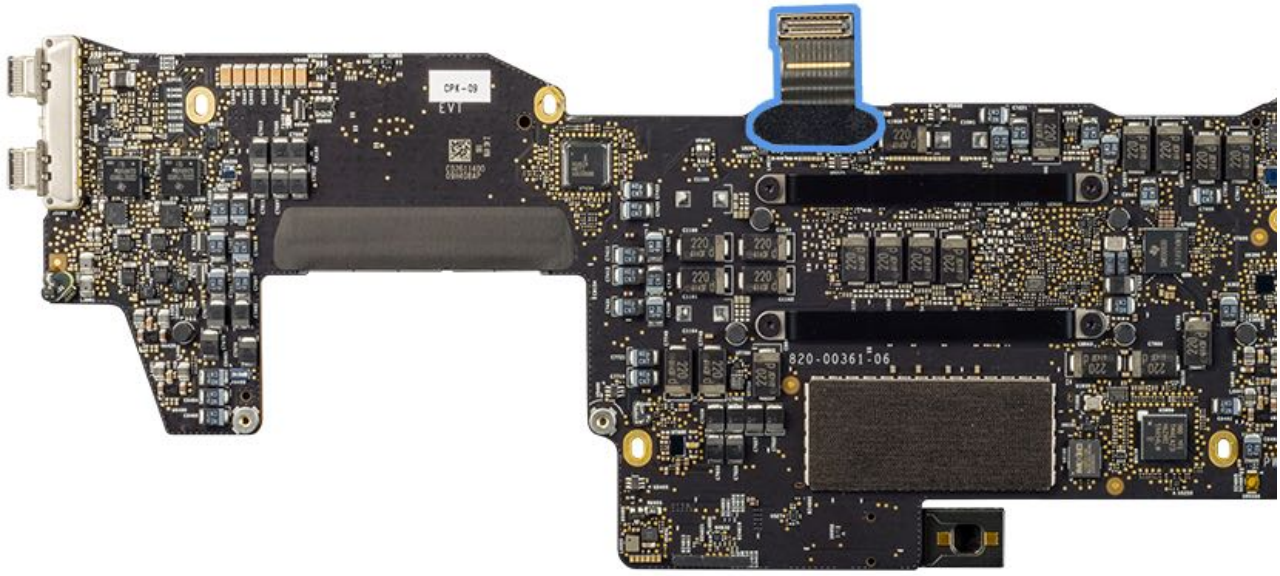


Steps For Reassembly

1. Reinstall two T3 screws (923-01190) to the eDP flex cable.



2. Fasten the Mylar cowling over the eDP cable.



3. Reinstall the logic board.
4. Reinstall the vent/antenna module.
5. Reinstall the TCON board.
6. Reinstall the flash storage if removed previously.
7. Reinstall the speakers if removed previously.
8. Reinstall the clutch covers.
9. Reinstall the T5 BMU screw, reconnect the battery cable, and remove the battery cover.
10. Install a new BMU Mylar cover.
11. Reinstall the bottom case.
12. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
13. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Heat Sink

First Steps

Warning:

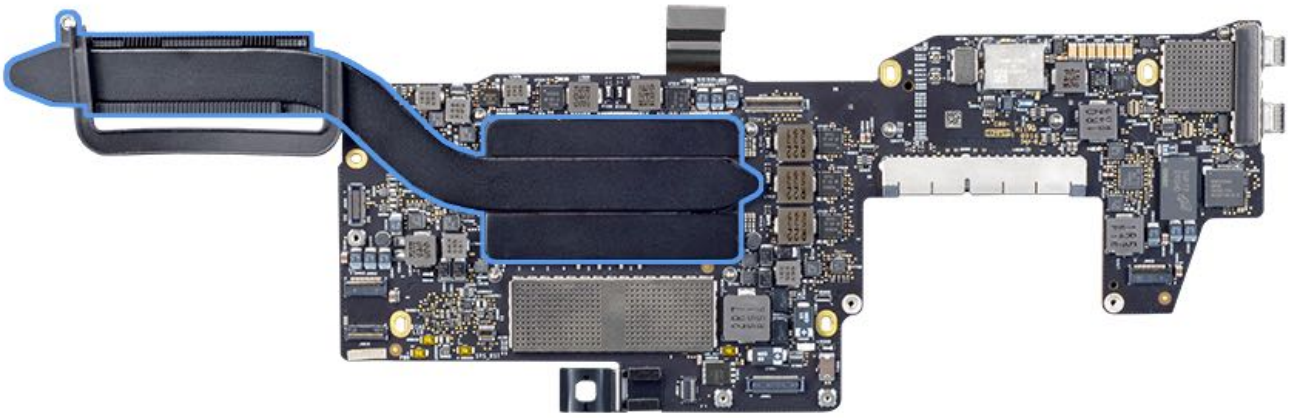
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Speakers
- Flash storage
- Embedded DisplayPort (eDP) cowlings
- Clutch covers
- TCON connector
- Vent/antenna module
- Logic board

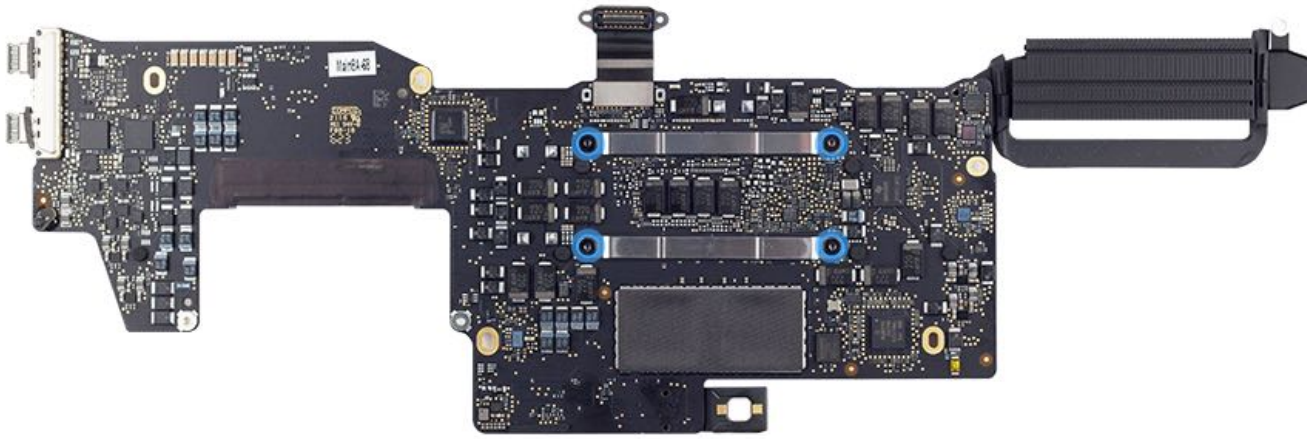


Tools

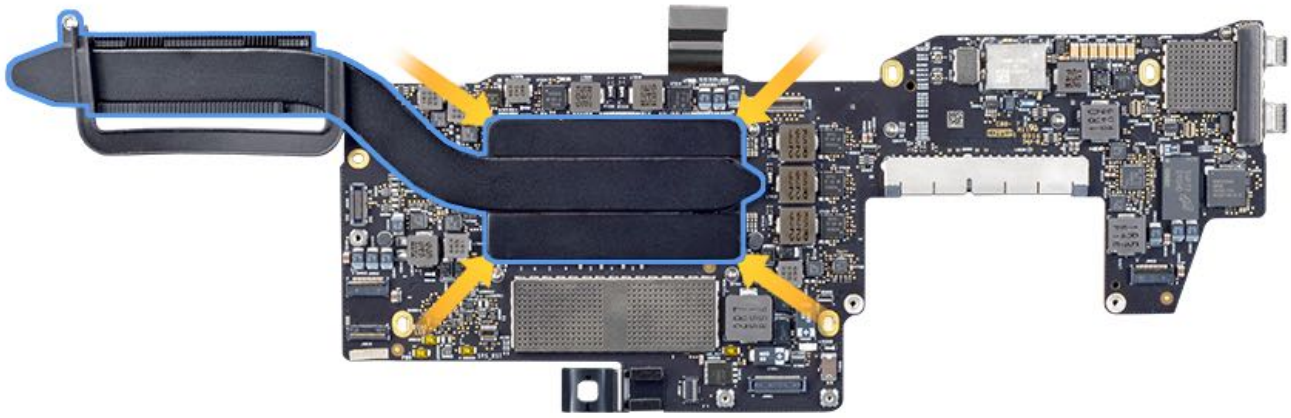
- ESD wrist strap
- Thermal grease syringe (922-7144)
- Torx T5 screwdriver (magnetized)
- Isopropyl alcohol (IPA) wipes

Steps For Removal

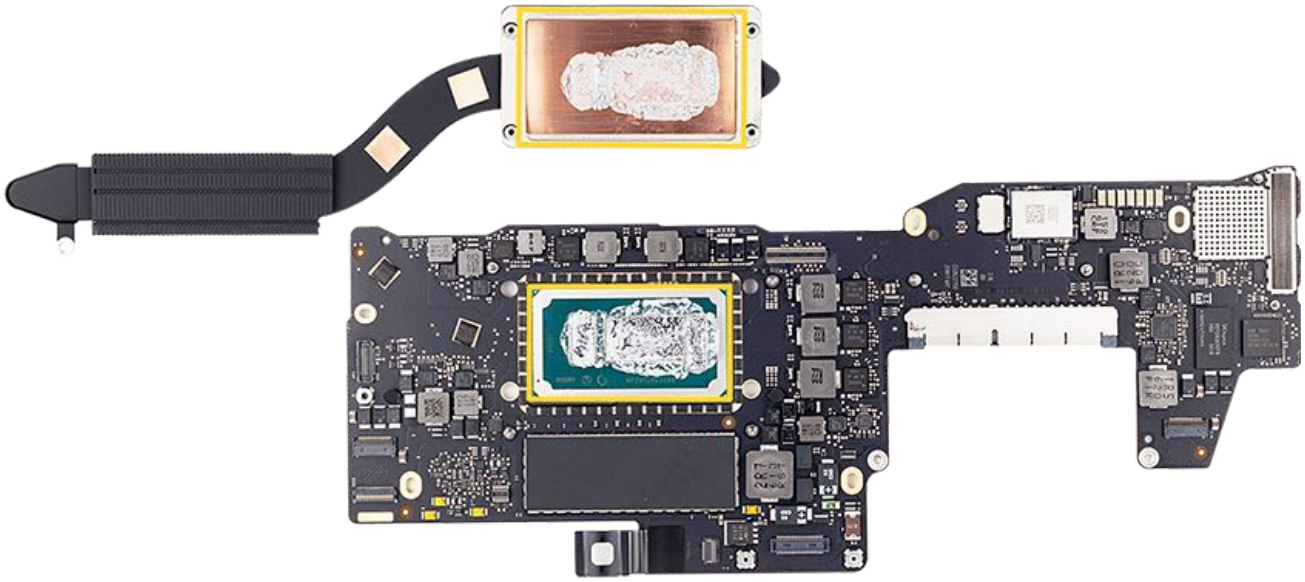
1. Turn the logic board over. Place the board on an ESD mat. Remove four T5 heat sink spring screws (923-01276).
Note: The heat sink springs are under tension. Gently hold down the spring when removing the first screw from each spring clip.



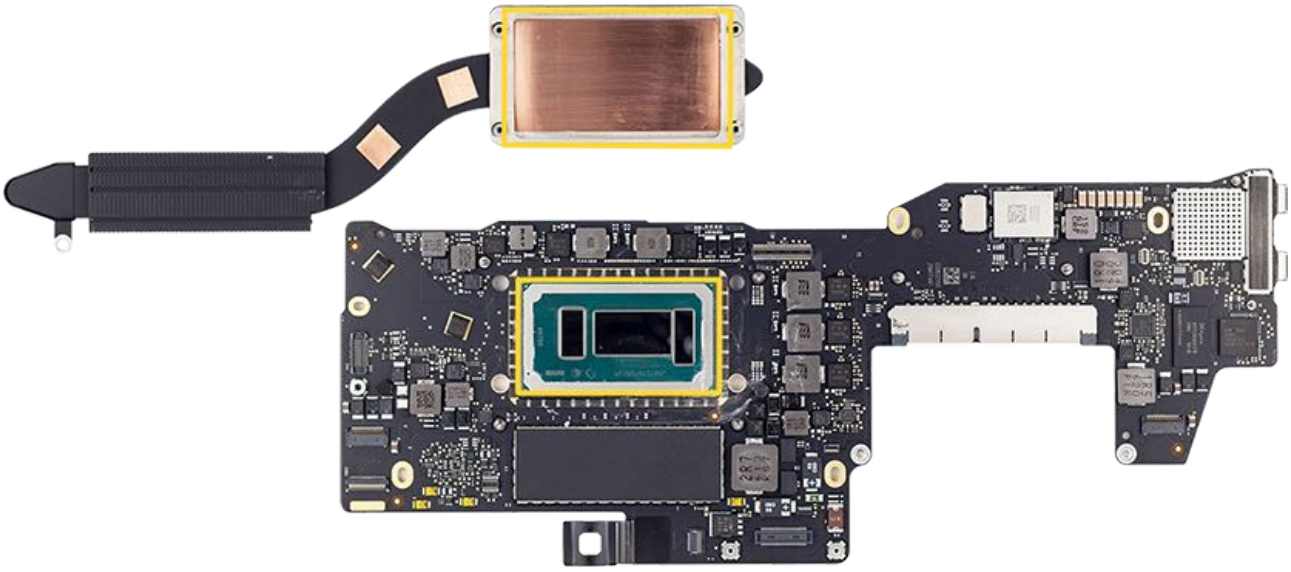
2. The heat sink should release from the logic board once the screws are removed. If the heat sink doesn't release, carefully turn the logic board over and gently wiggle the corners of the heat sink to loosen the thermal bond.
Note: Observe how the thermal gasket wraps around the heat sink arm.
Important: Always hold the heat sink by the body, never by the heat sink arm.



3. Use IPA wipes to clean the thermal grease from the heat sink and processor chip.
Before cleaning

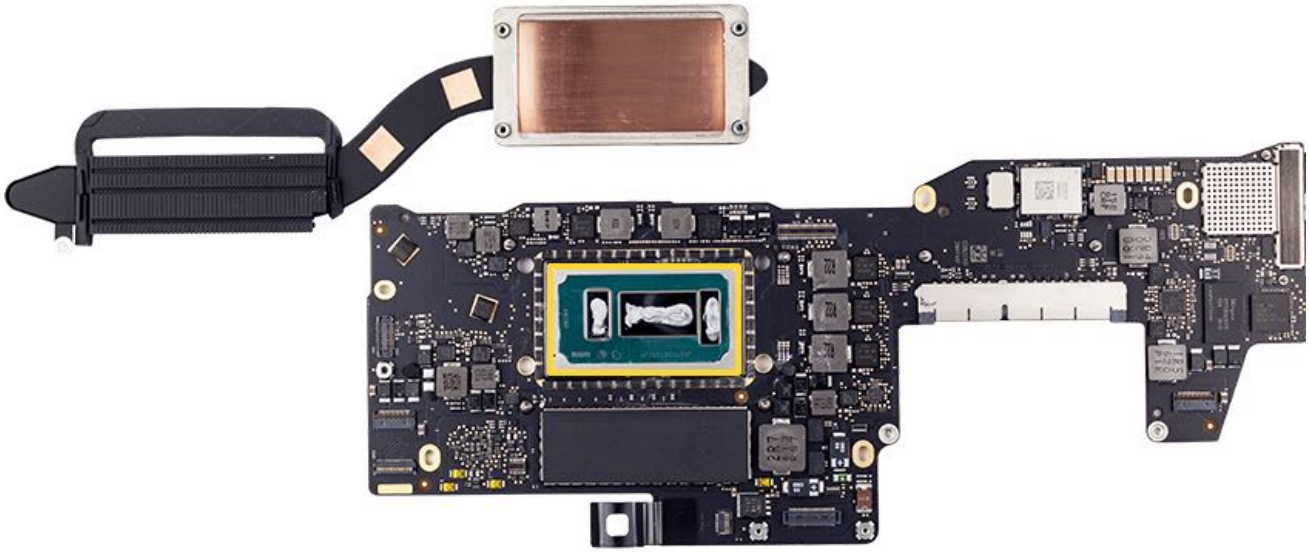


After cleaning

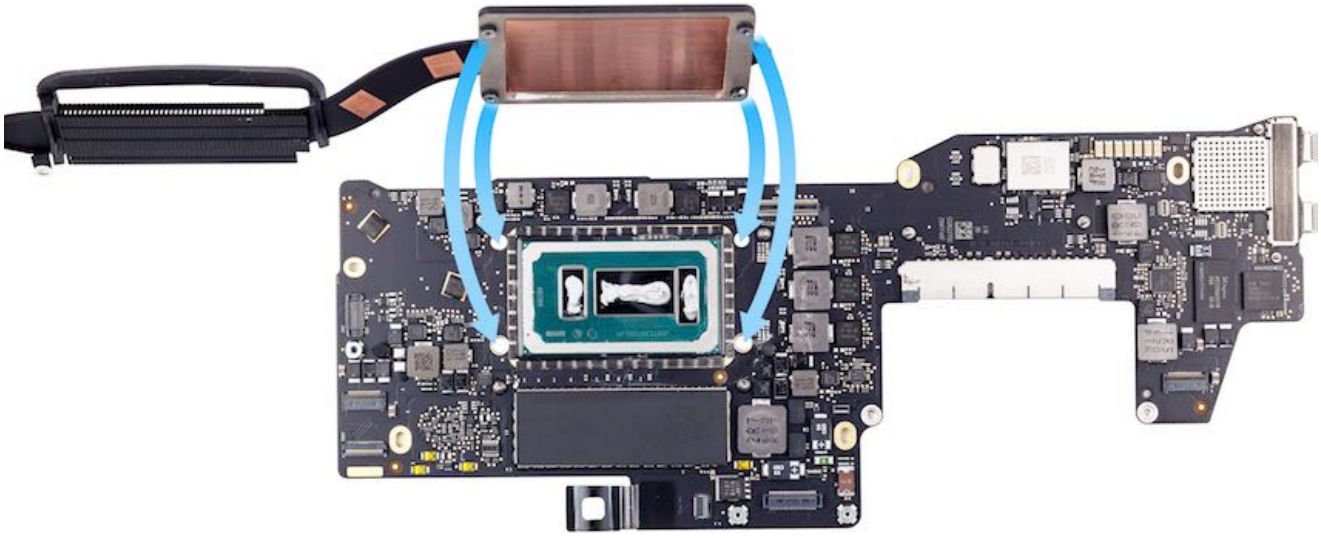


Steps For Reassembly

1. Inject a line of thermal grease on the three processor chips.

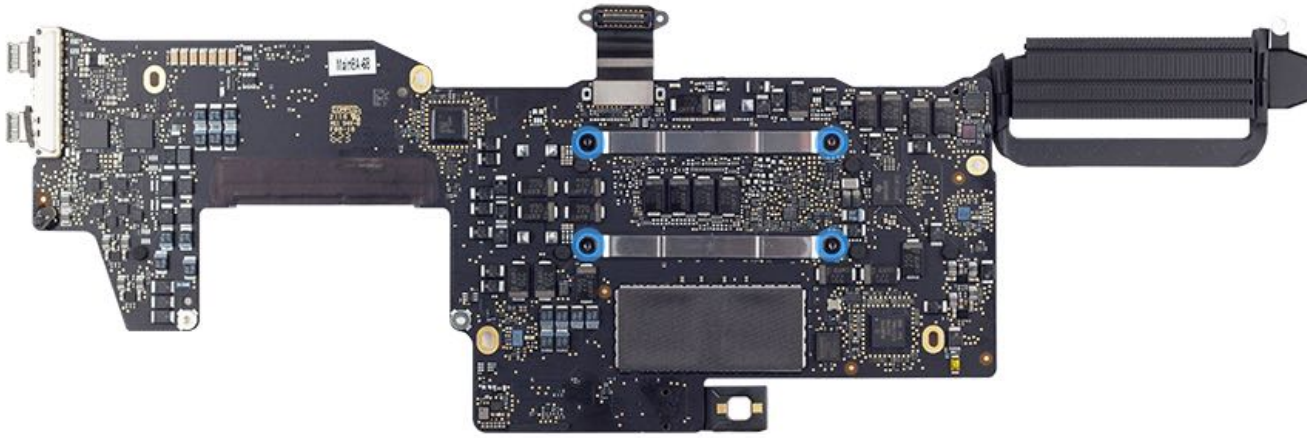


2. Carefully align the heat sink screw bosses with the screw holes on the logic board. Hold the heat sink in place as you carefully turn over the logic board to reinstall the screws.

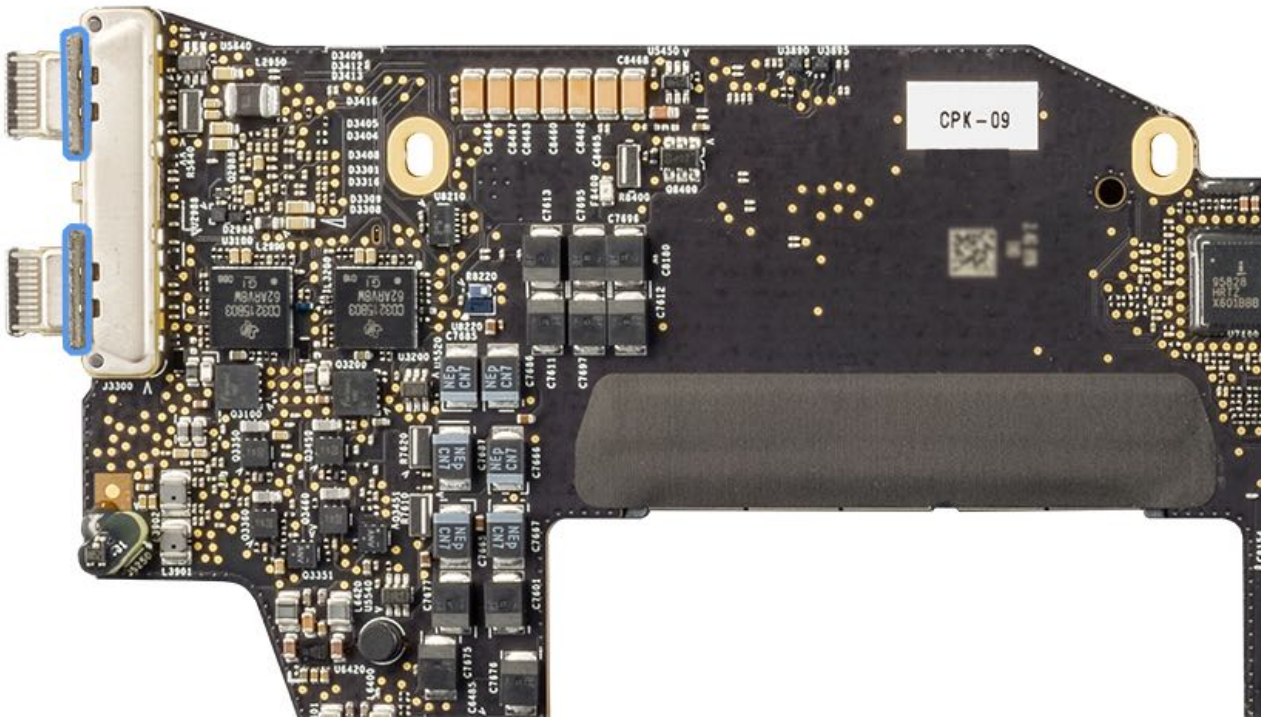


3. Reinstall the heat sink springs and four T5 heat sink spring screws (923-01276). **Note:** The heat sink springs are under

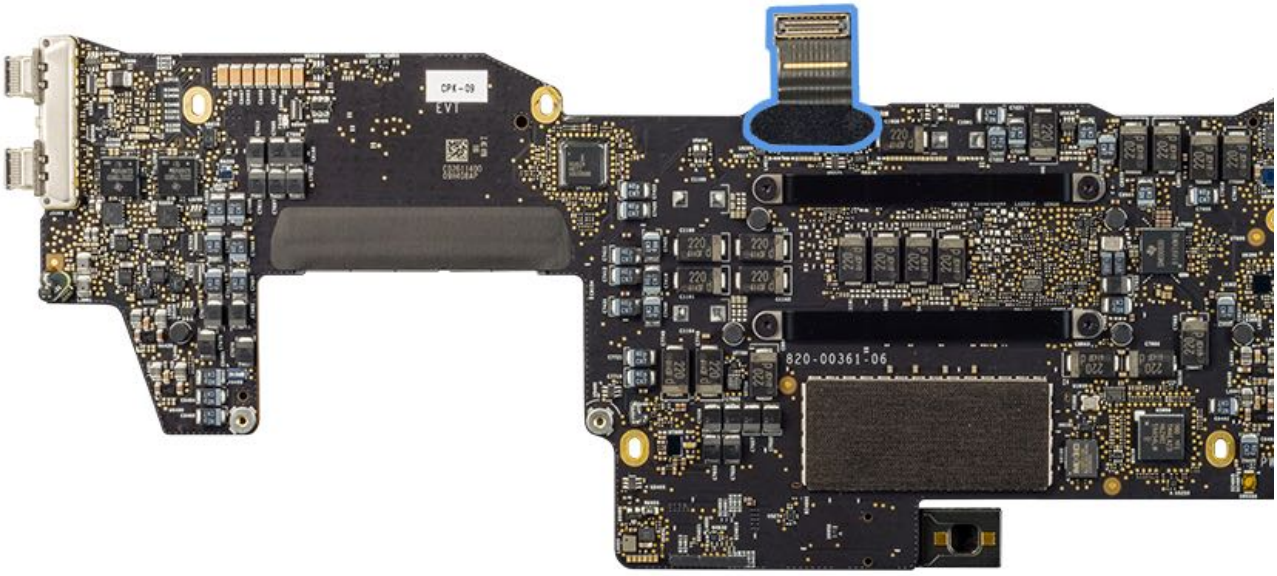
tension. Gently hold down the spring when replacing the second screw on each spring clip.



4. Check that the foam gaskets (shown below) are present on the Thunderbolt 3 ports. If a gasket is missing, order part number 923-01172.



5. Check that the eDP flex cable is attached to the logic board.



6. Reinstall the logic board into the top case, aligning the two Thunderbolt 3 ports with the openings in the top case.
7. Reinstall the vent/antenna module.
8. Reinstall the TCON board.
9. Reinstall the Embedded DisplayPort (eDP) cowlings.
10. Reinstall the clutch covers.
11. Reinstall the flash storage if removed previously.
12. Reinstall the speakers if removed previously.
13. Reinstall the BMU screw, reconnect the battery cable, and remove the battery cover.
14. Install a new BMU Mylar cover.
15. Reinstall the bottom case.
16. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
17. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Fan

First Steps

Warning:

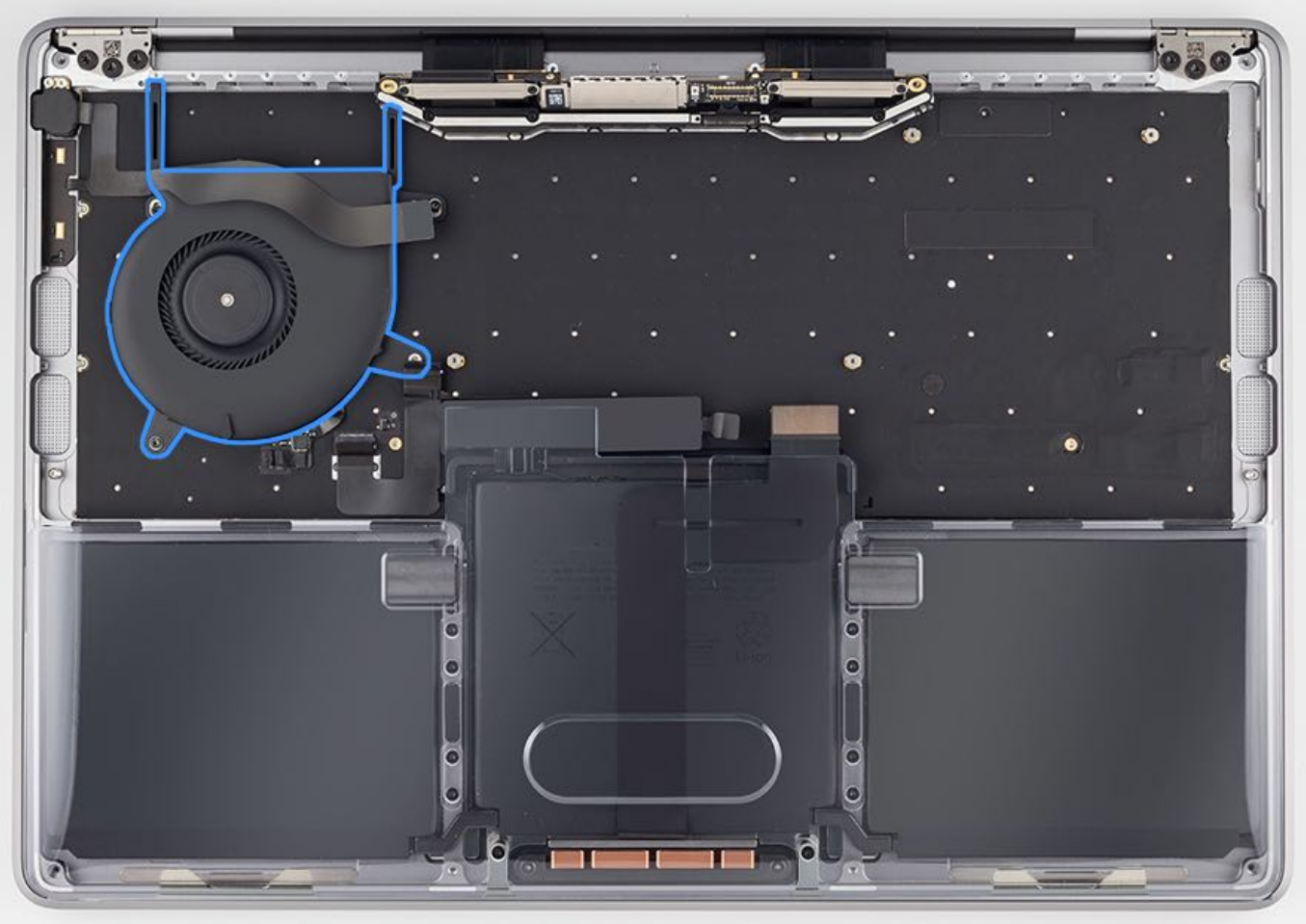
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Speakers (optional)
- Flash storage (optional)
- Embedded DisplayPort (eDP) cowlings
- Clutch covers
- TCON board screws
- Vent/antenna module
- Logic board



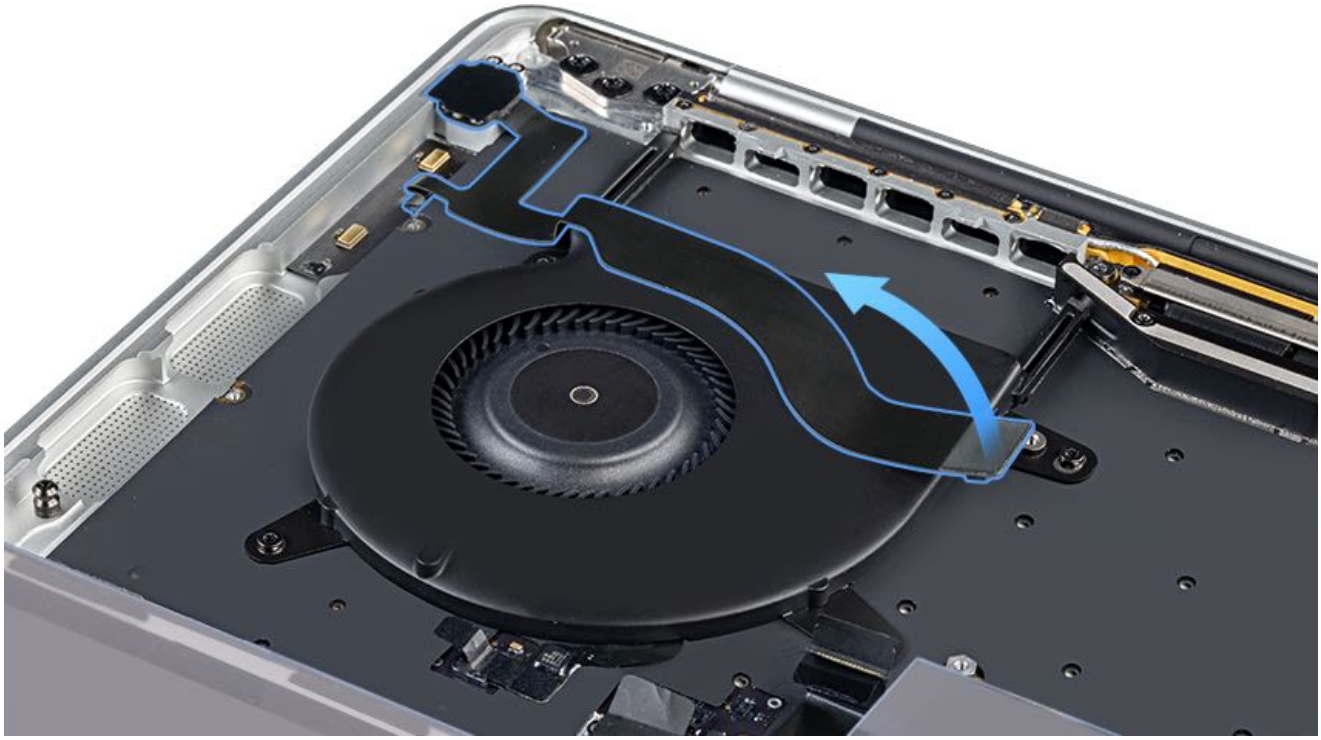
Tools

- ESD wrist strap
- Tweezers

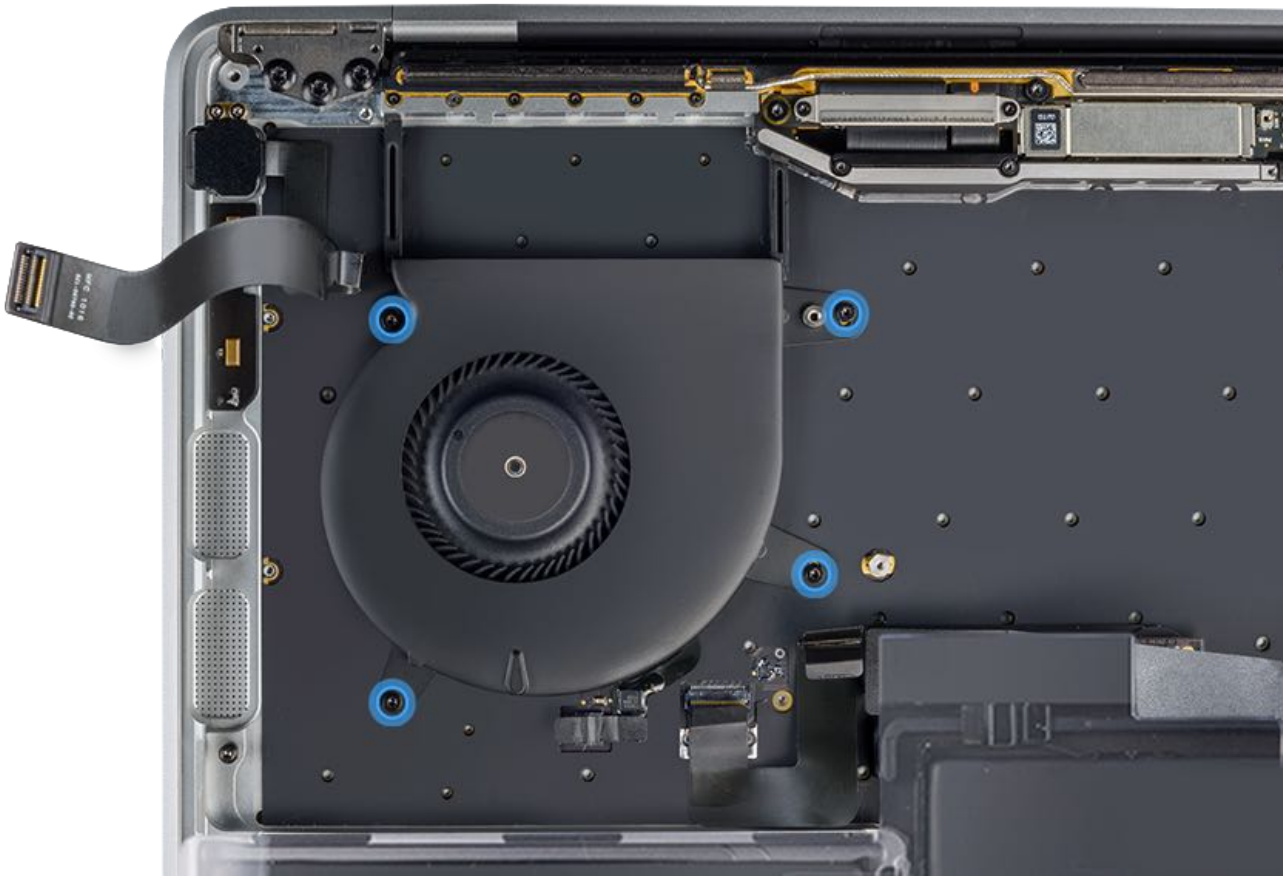
- Black stick
- Torx T5 screwdriver (magnetized)
- Battery cover (923-01318)

Steps For Removal

1. Carefully peel back the audio flex cable off the top of the fan.
   Note: The audio flex cable is part of the top case.

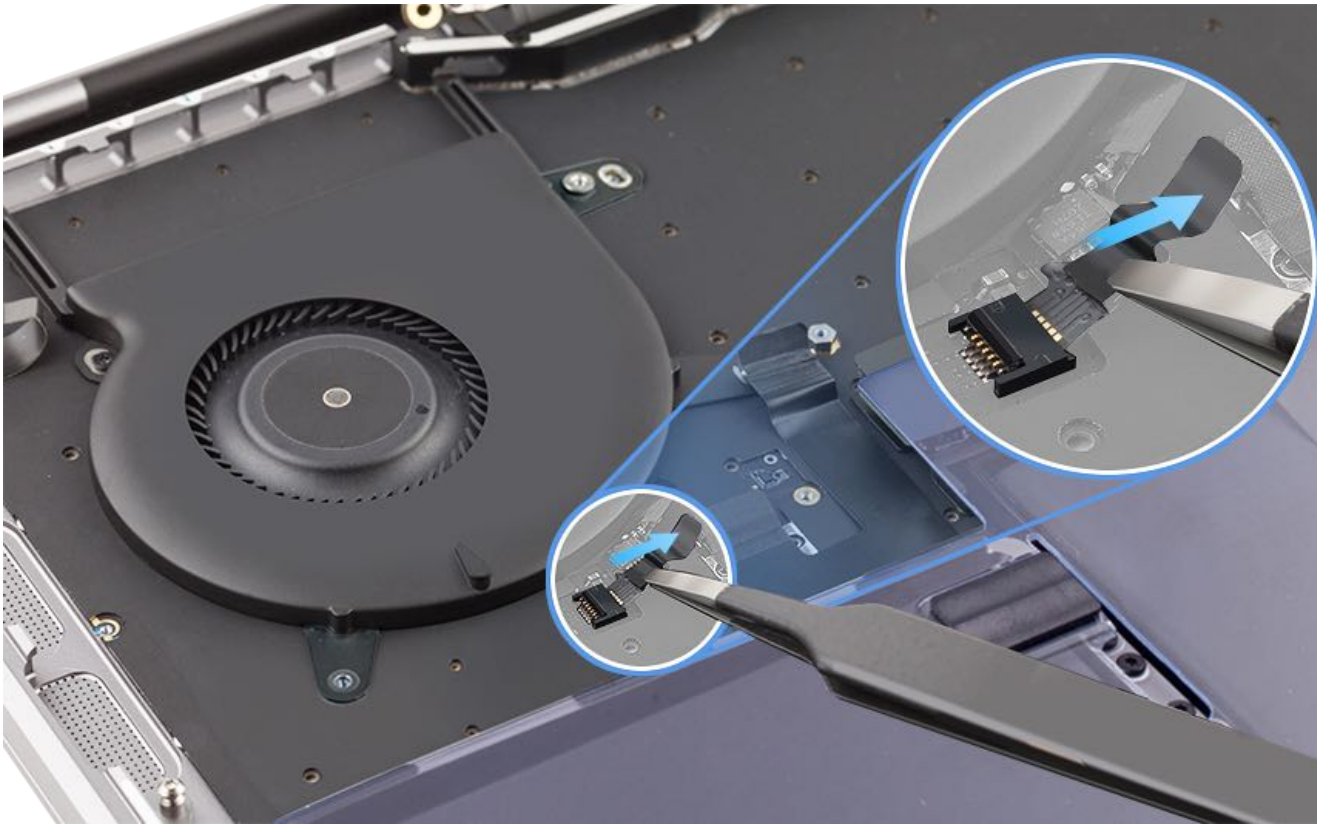


2. Remove four T5 fan screws (923-01174).



3. Peel back the tab on the fan flex cable to see the locking lever. Use the flat end of a black stick to lift the locking lever on the connector.

4. Use a tweezers to gently disconnect the fan flex cable from the connector on the top case. Remove the fan from the top case.



Steps For Reassembly

1. Reinstall the fan into the top case.
2. Reconnect the fan flex cable to the top case and press the connector’s locking lever flat.
3. Reinstall four T5 fan screws.
4. Reinstall the logic board into the top case, aligning the two Thunderbolt 3 ports with the openings in the top case.
5. Reinstall the vent/antenna module.
6. Reinstall the TCON board.
7. Reinstall the Embedded DisplayPort (eDP) cowlings.
8. Reinstall the clutch covers.
9. Reinstall the flash storage if removed previously.
10. Reinstall the speakers if removed previously.
11. Reinstall the BMU screw, reconnect the battery cable, and remove the battery cover.
12. Install a new BMU Mylar cover.
13. Reinstall the bottom case.
14. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
15. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Display Assembly

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Embedded DisplayPort (eDP) cowlings
- Clutch covers
- Vent/antenna module

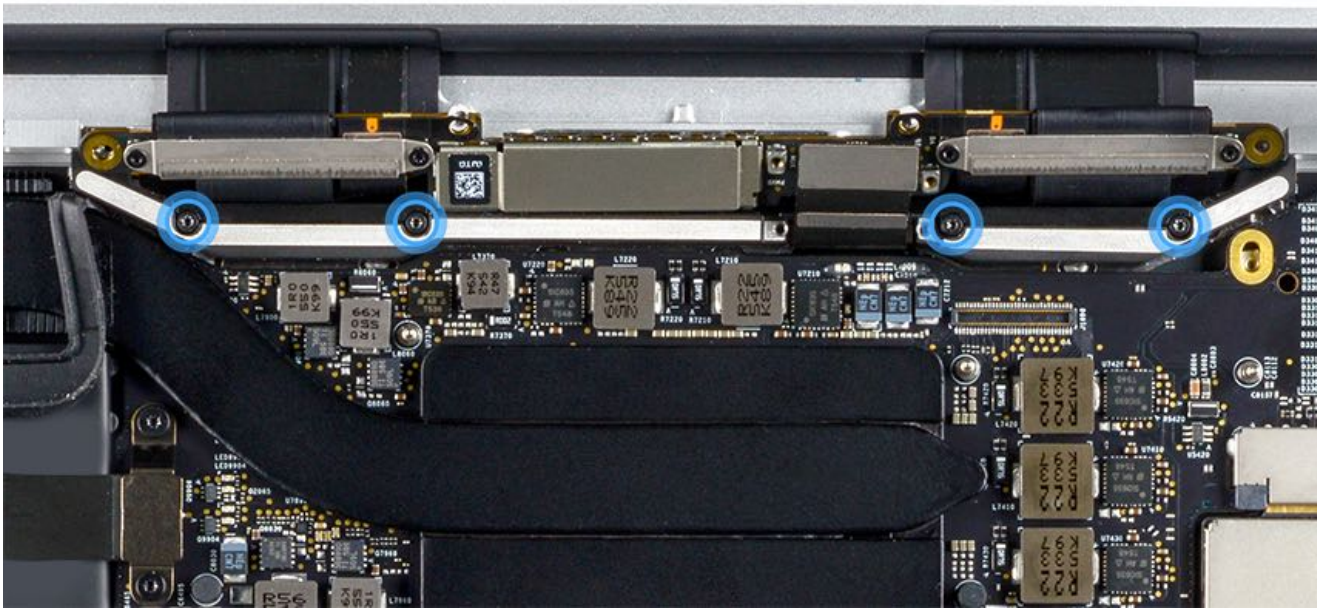
For video instruction, refer to article SV310: Display Assembly Replacement Video.

Tools

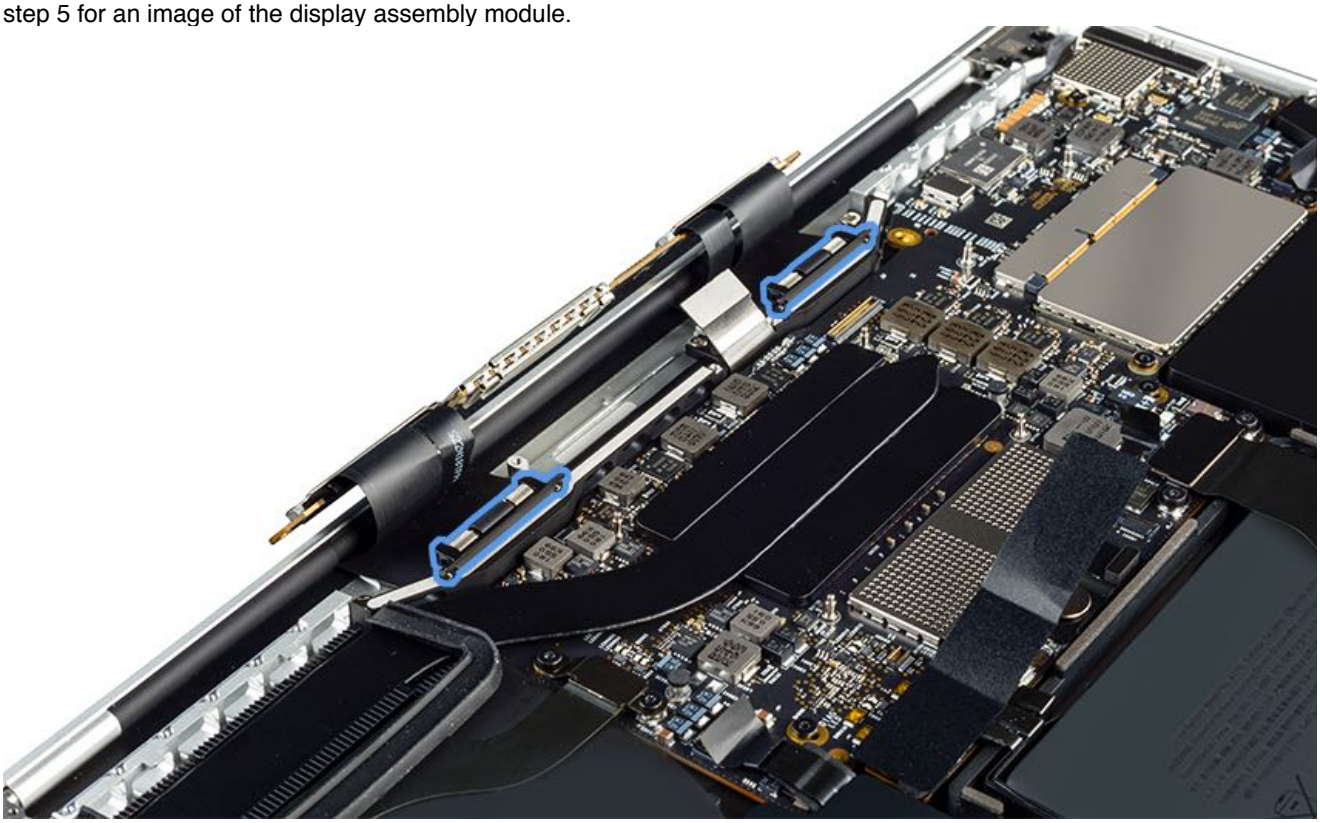
- ESD strap
- Black stick
- Torx T3 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Battery cover (923-01318)

Steps For Removal

1. Remove four T3 spring tensioner screws (923-01185) secured to the rear wall.

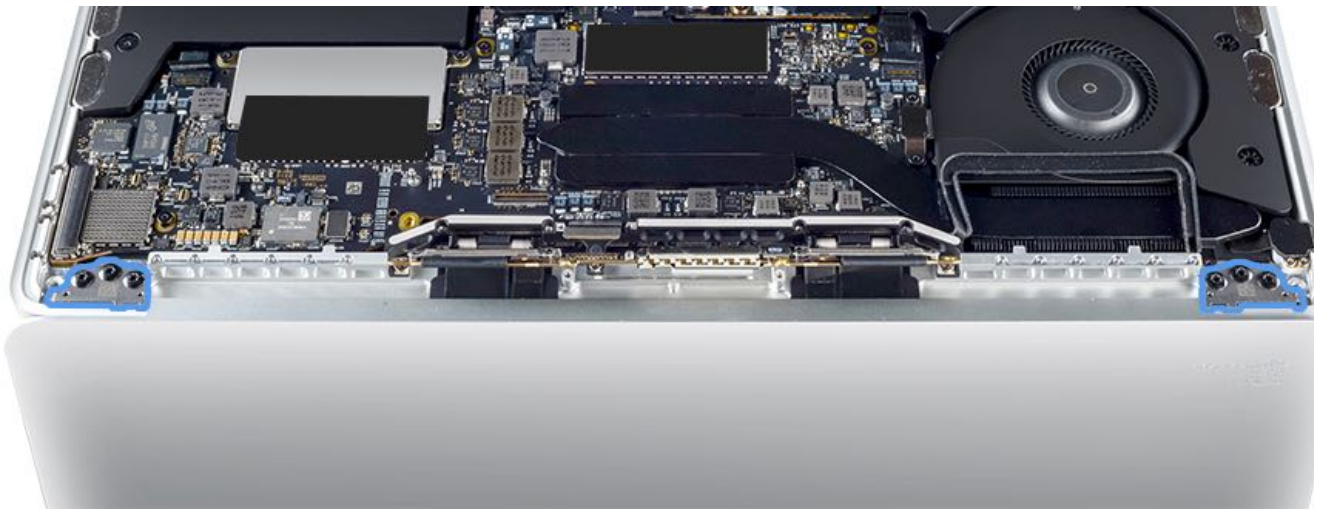


Note: The spring tensioners (highlighted below) and the TCON board are part of the display assembly module. Refer to step 5 for an image of the display assembly module.

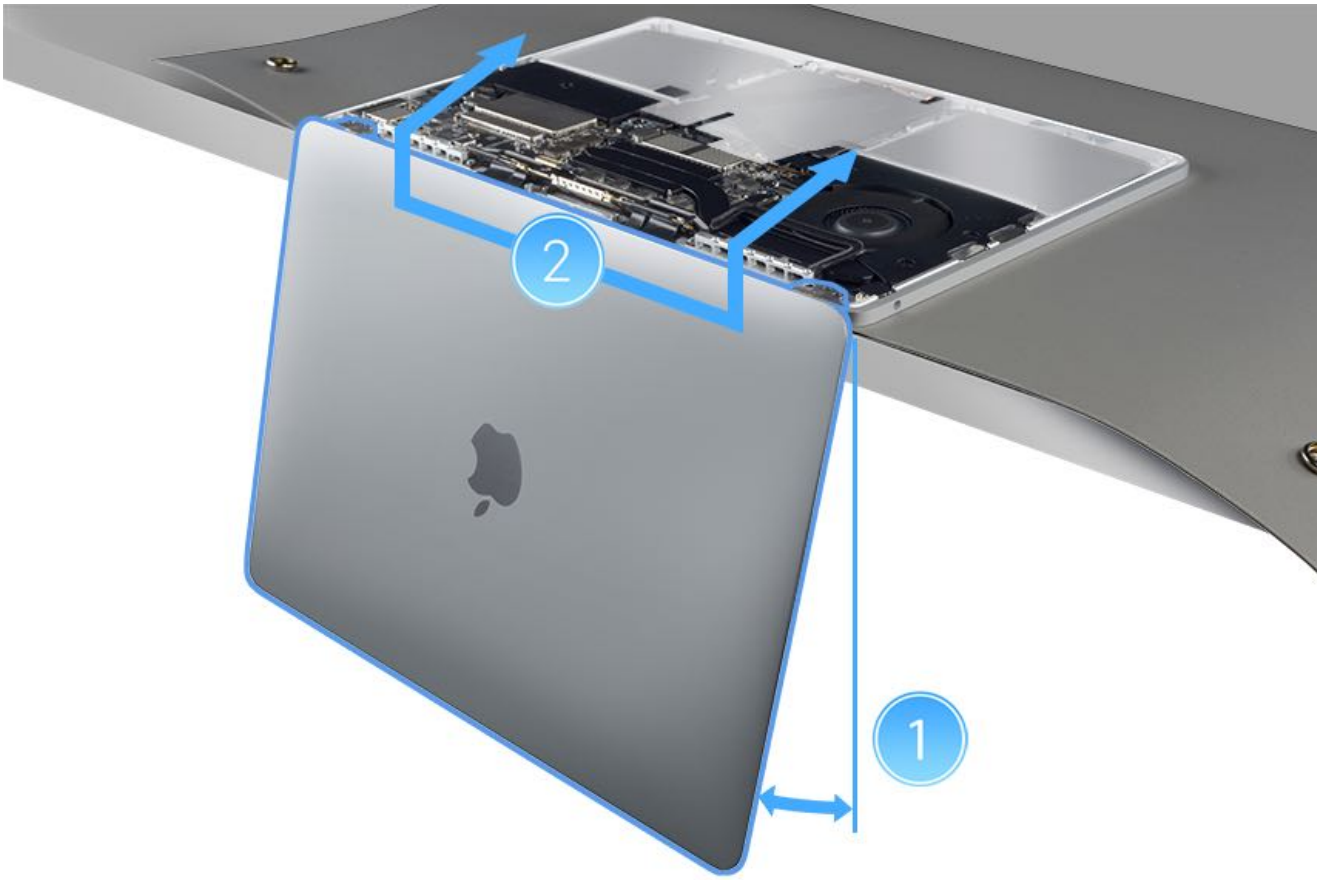


2. Open the display and place the computer on the edge of a workbench, with the display hanging down.

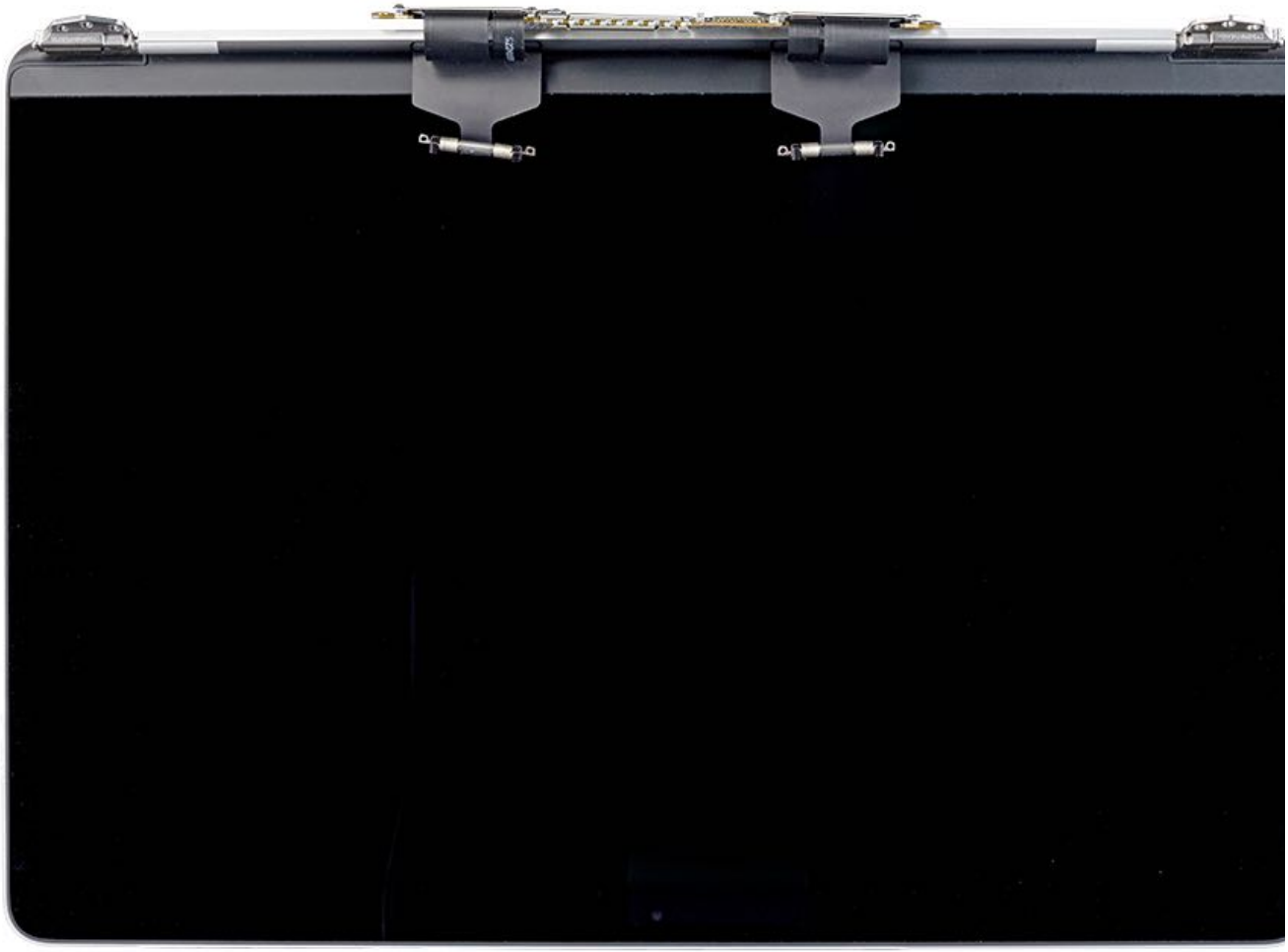
3. Remove six T8 display clutch screws (923-01173).



4. Separate the display assembly from the top case. Pull the display toward you about 15 degrees (1), then lift the display (2) up and off the top case.



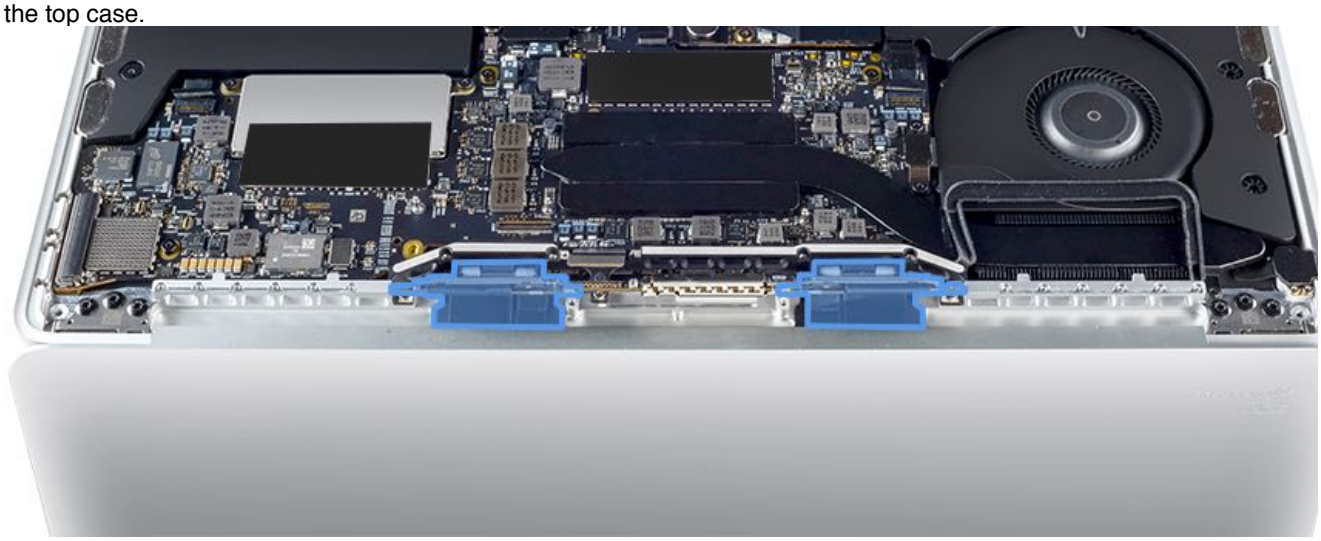
5. This is the display assembly module, which includes the TCON board and spring tensioners.



Steps For Reassembly

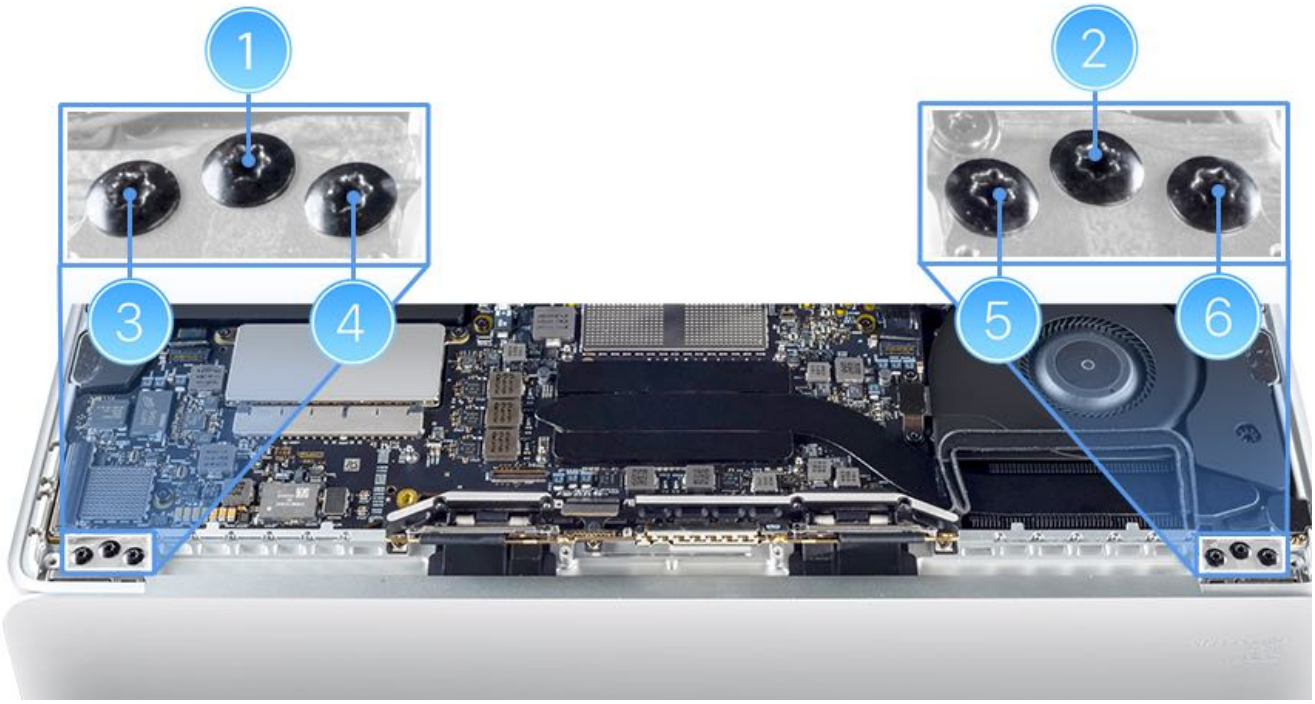
1. Reinstall the display onto the top case. Make sure that the TCON board and spring tensioner cables are positioned in

the top case.

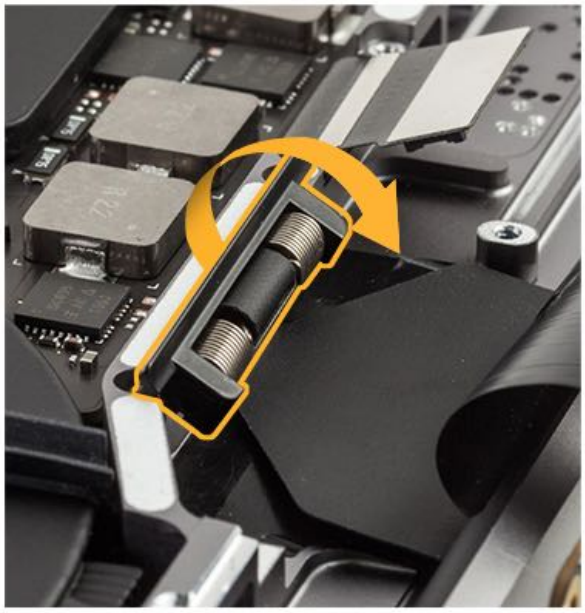


Note: If reassembled incorrectly, the spring tensioner cables could get wedged between the hinge and display, as shown in the second image.

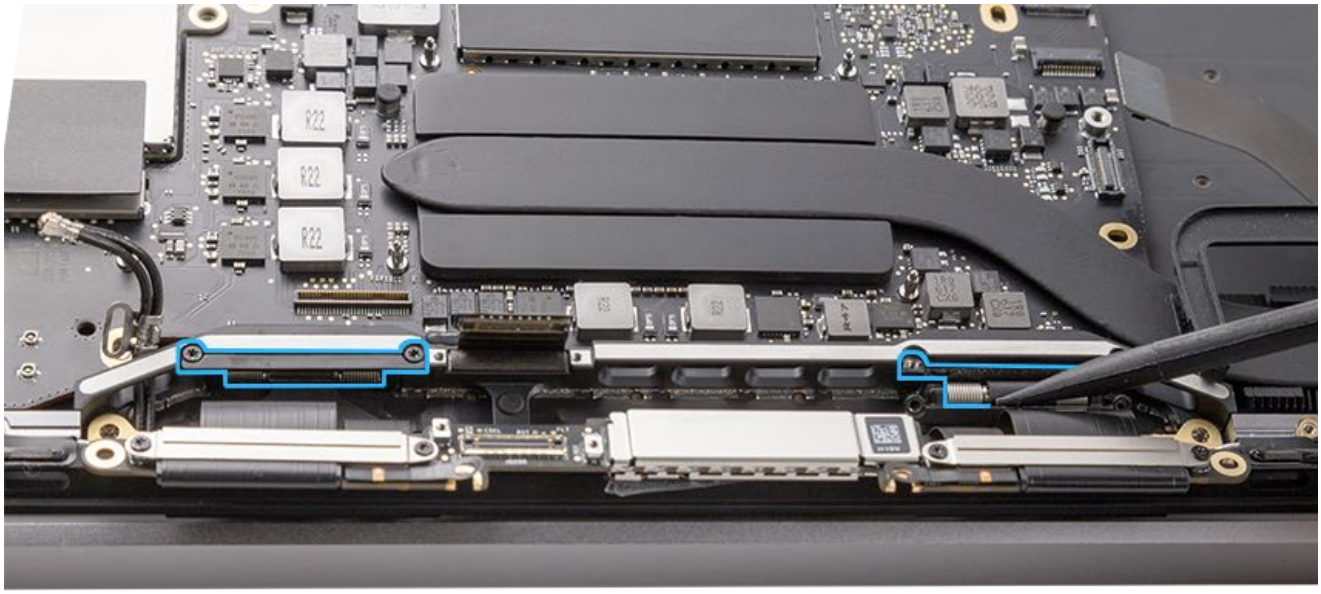
2. Reassemble and align the display assembly:
   - Loosely reinstall the six T8 display clutch screws in the order shown.
   - Close the display.
   - Align the display to the top case.
   - Tighten all six T8 screws.



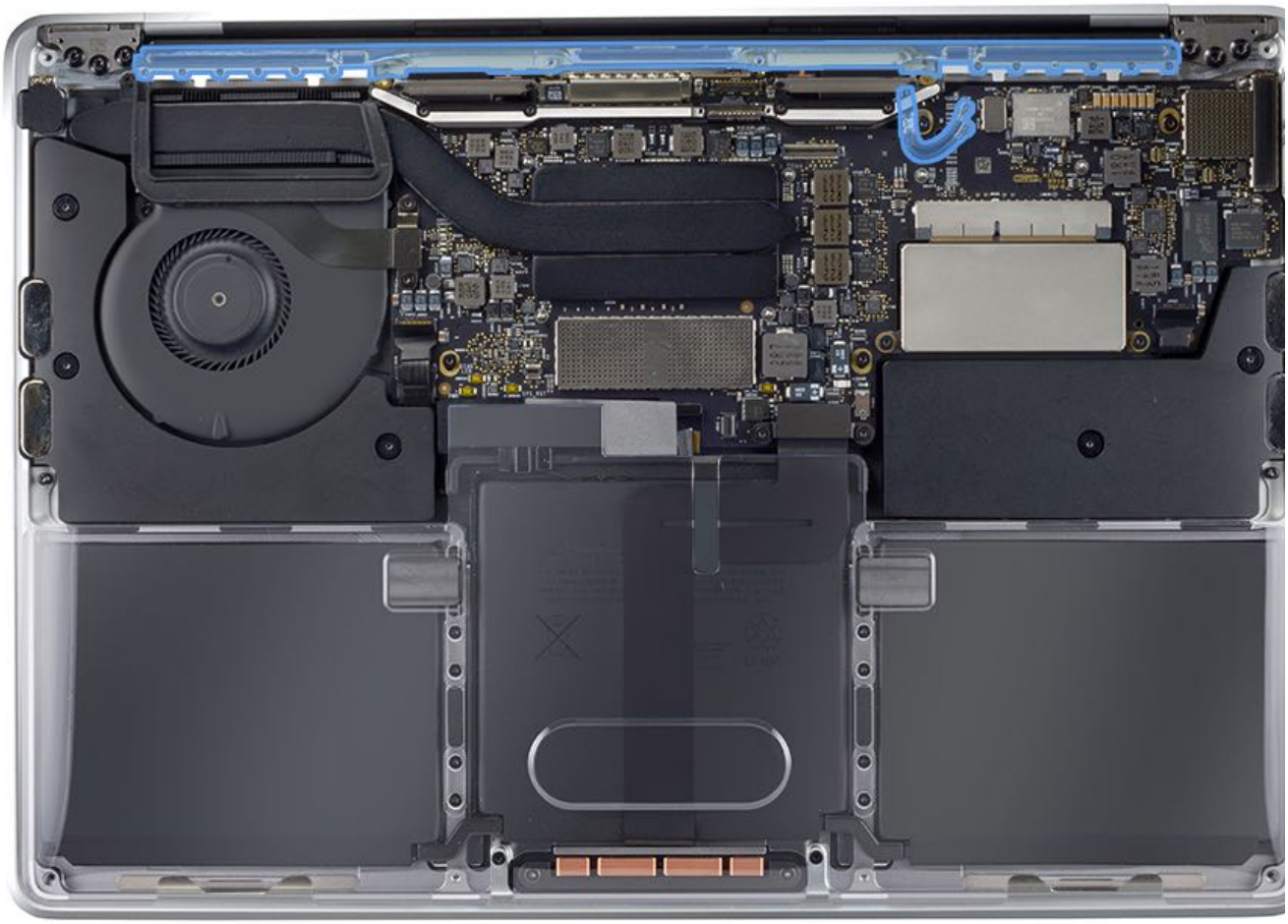
3. Roll and tuck the body of each spring tensioner under the rear wall. The spring tensioner bar fits flush against the rear wall.
   Important: Make sure the spring tensioners are beneath the TCON board.

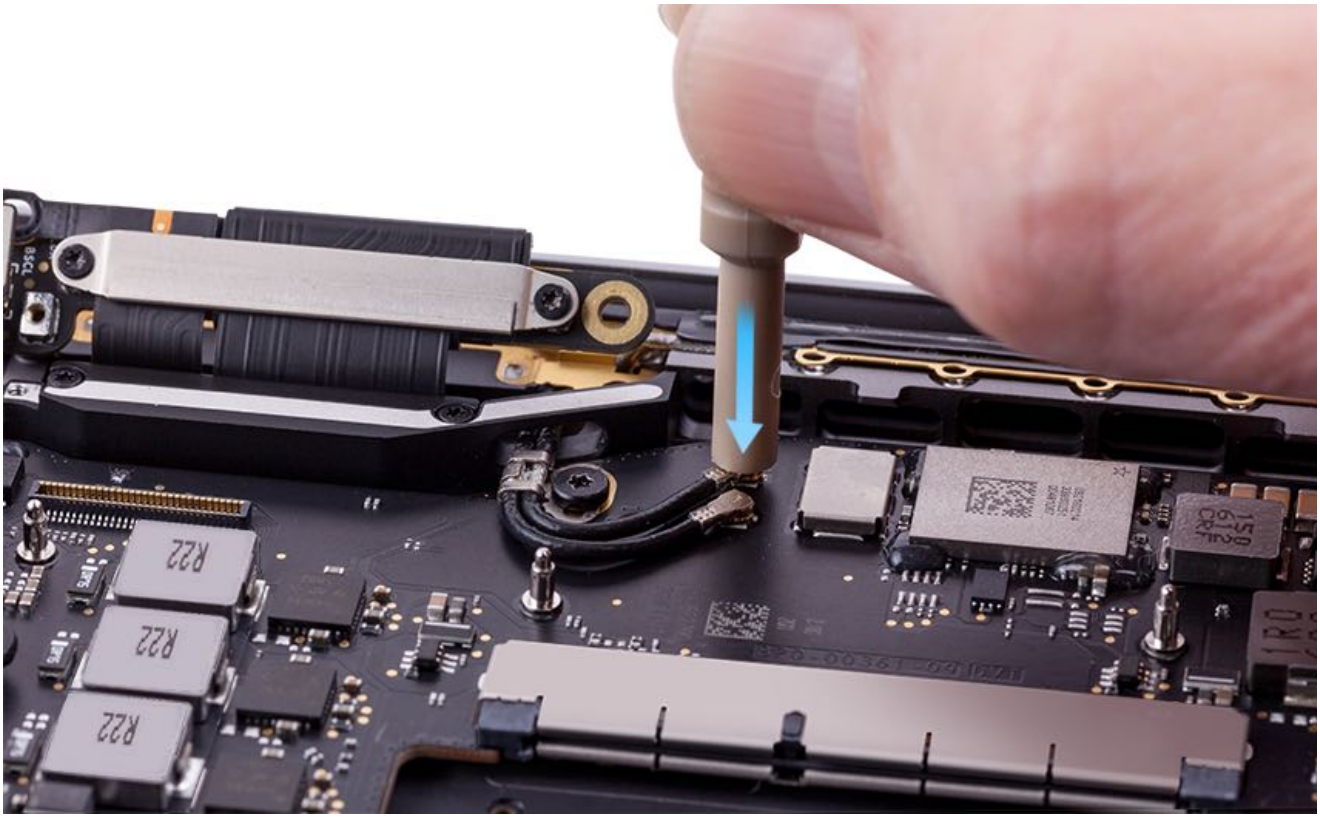


4. Reinstall two T3 screws on each spring tensioner.
   Note: The image below shows one spring tensioner not installed yet and the other spring tensioner with the screws installed on the rear wall.

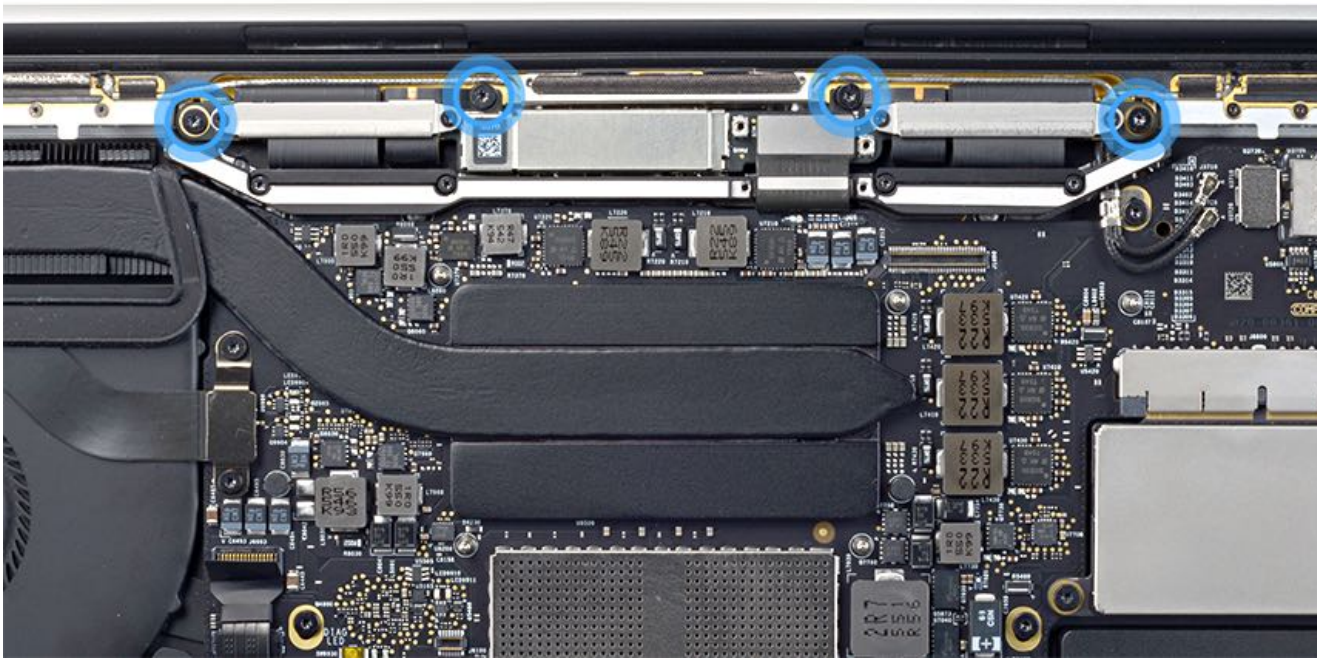


5. Reinstall the vent/antenna module. Gently press down on the middle of the vent/antenna module to seat the module into the top case.
   - Reinstall twelve IPR vent/antenna screws
   - Reinstall the T5 antenna screw
   - Reconnect the two antennas using a tweezers or the antenna tool

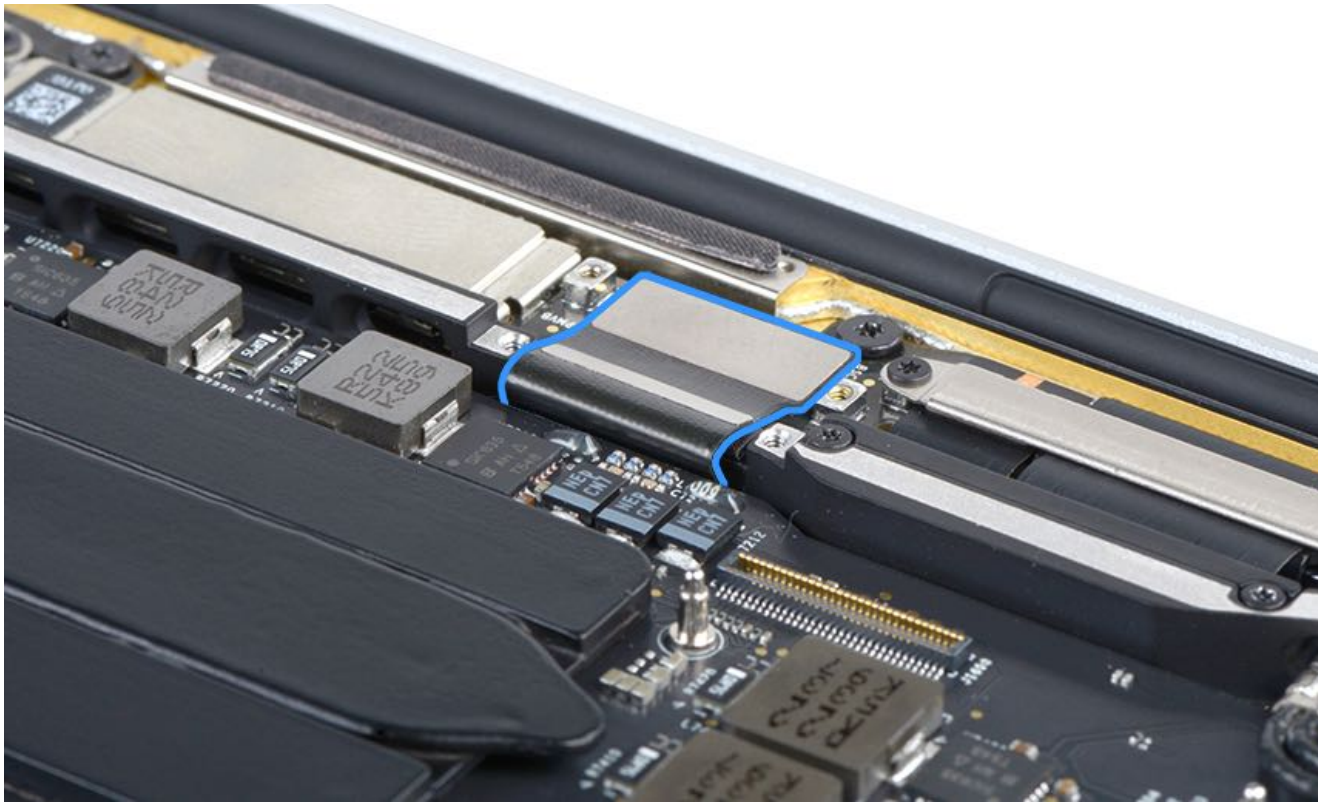




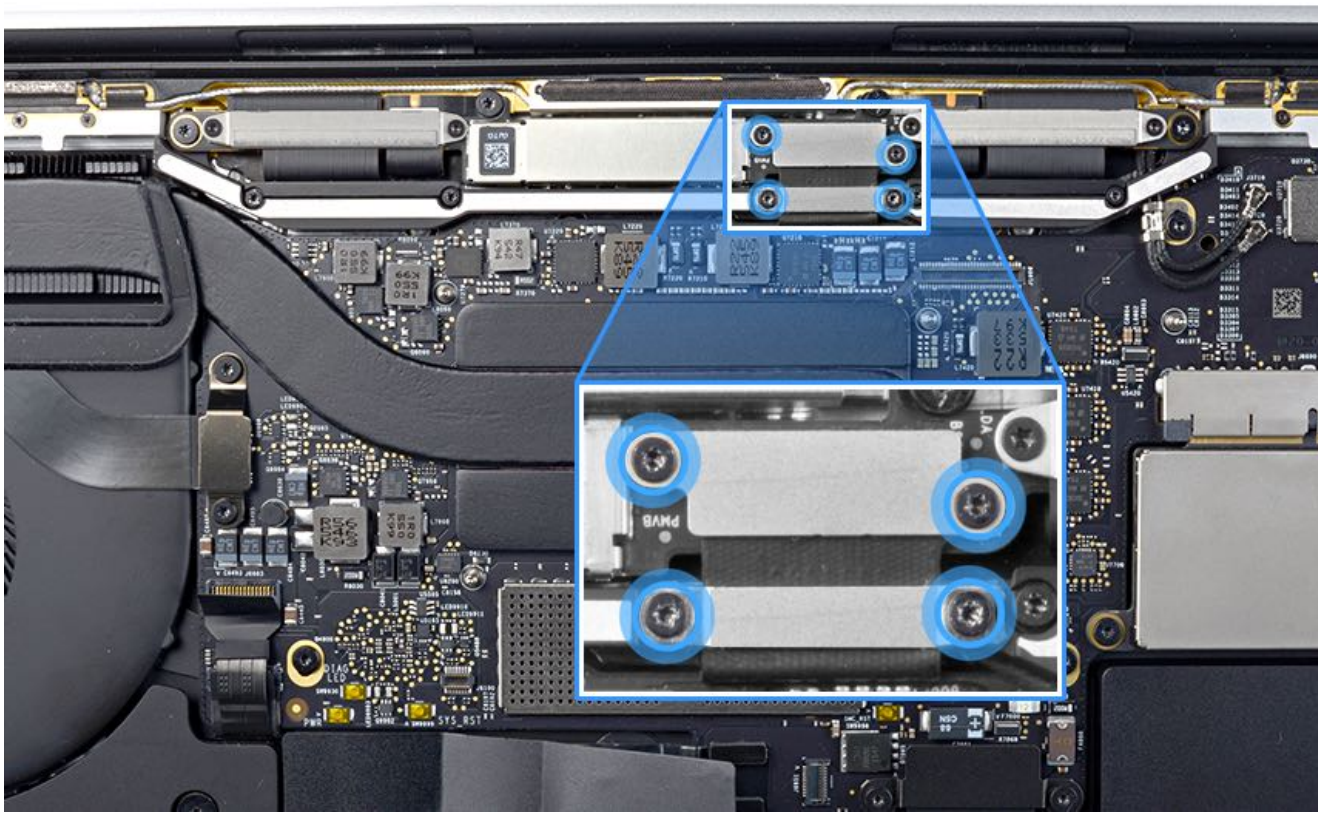
6. Reinstall the four T5 TCON board screws. **Note:** The shoulder screws are the two outer screws.



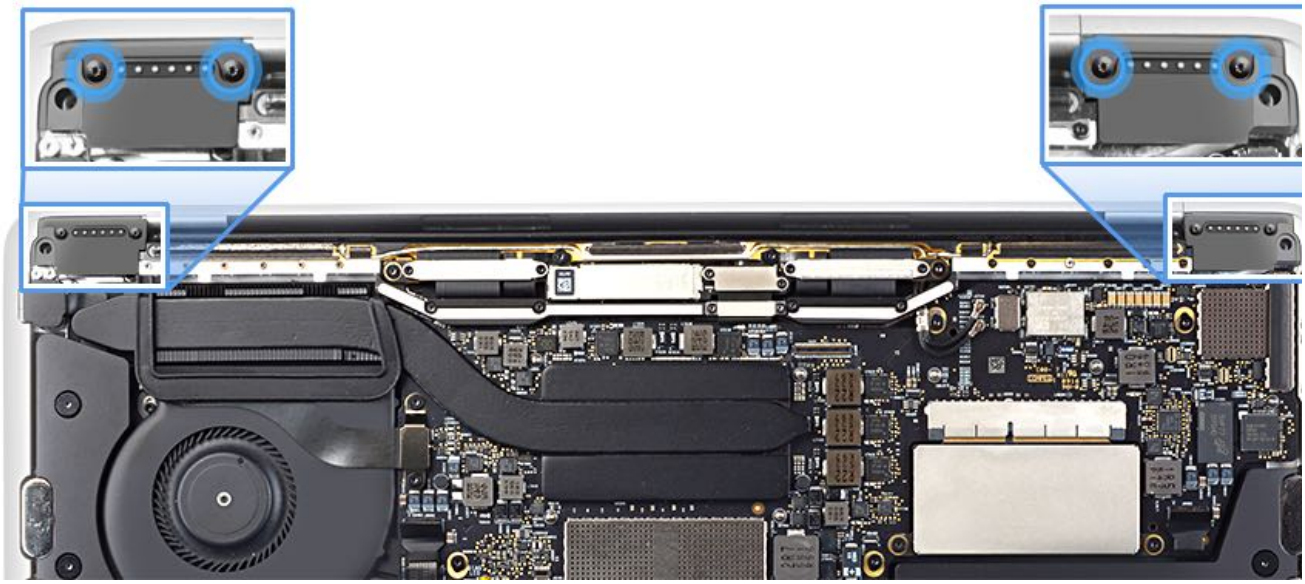
7. Reconnect the eDP flex cable to the TCON board.



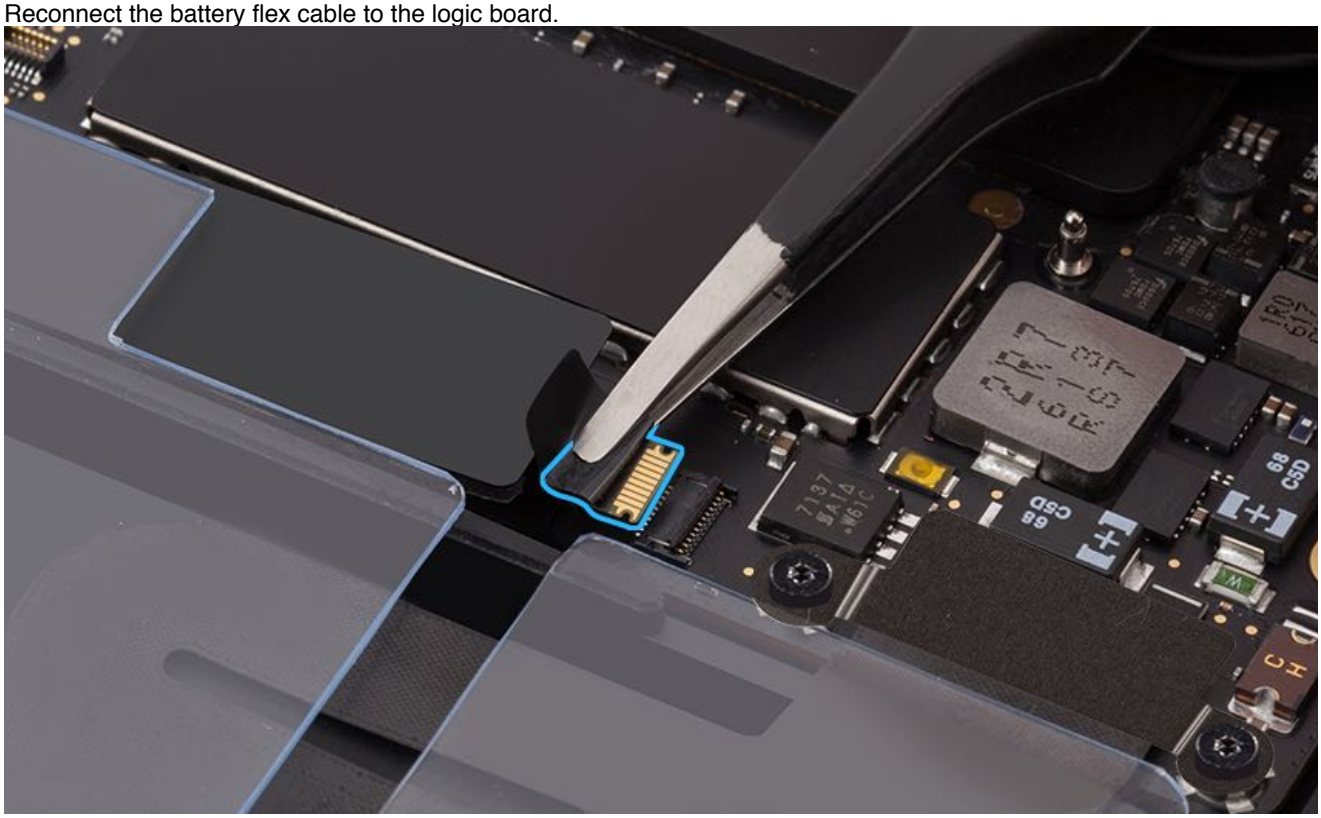
8. Reinstall the two eDP flex cable cowlings and four T3 cowling screws. Make sure the gasket on the lower cowling makes contact with the eDP cable. **Note:** The upper cowling uses the shorter screws.



9. Replace the clutch covers and four T3 screws.



10. Reconnect the battery flex cable to the logic board.



11. Remove the battery cover.
12. Reinstall the bottom case.
13. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
14. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Keyboard Flex Cable

First Steps

Warning:

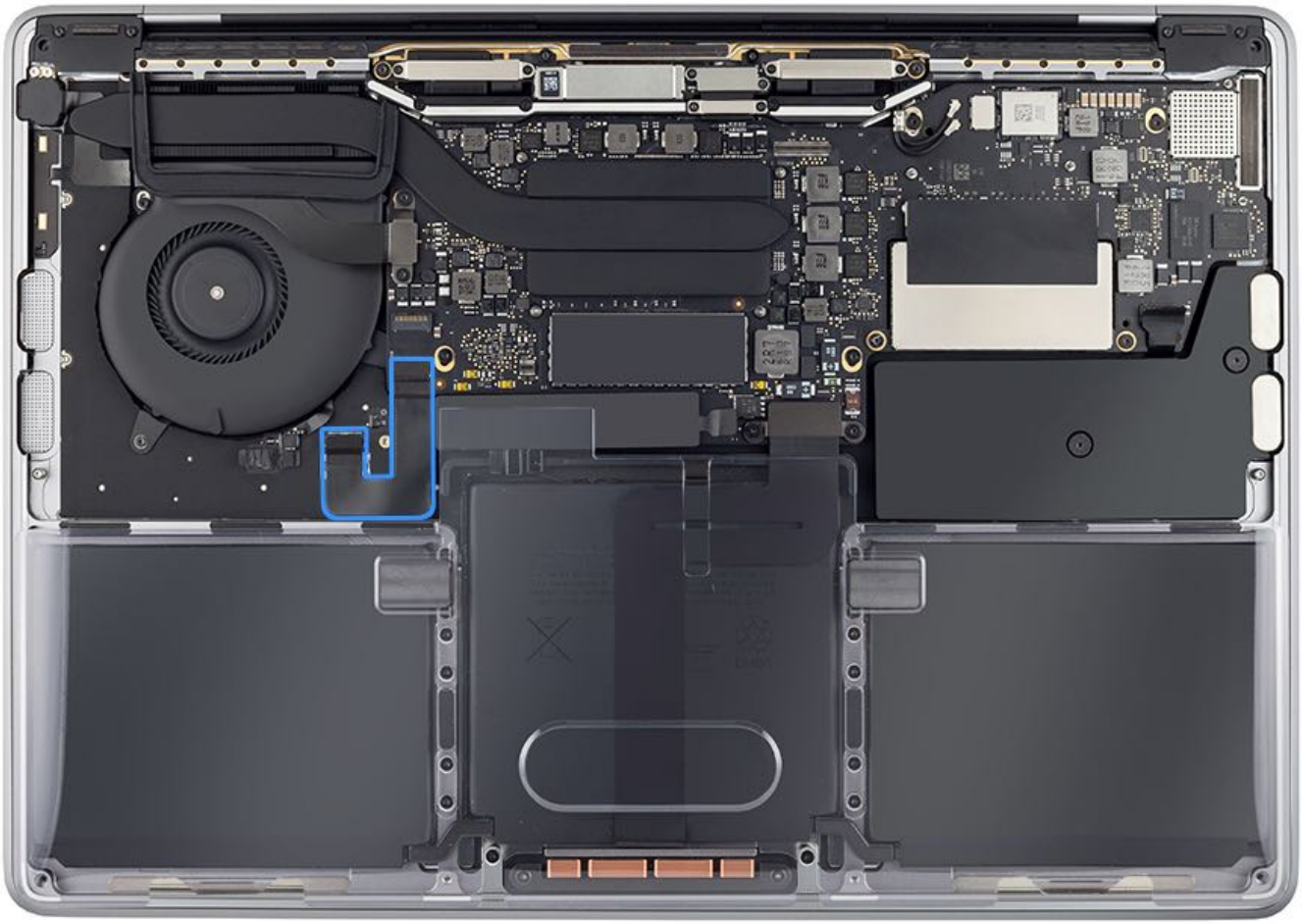
- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Right speaker

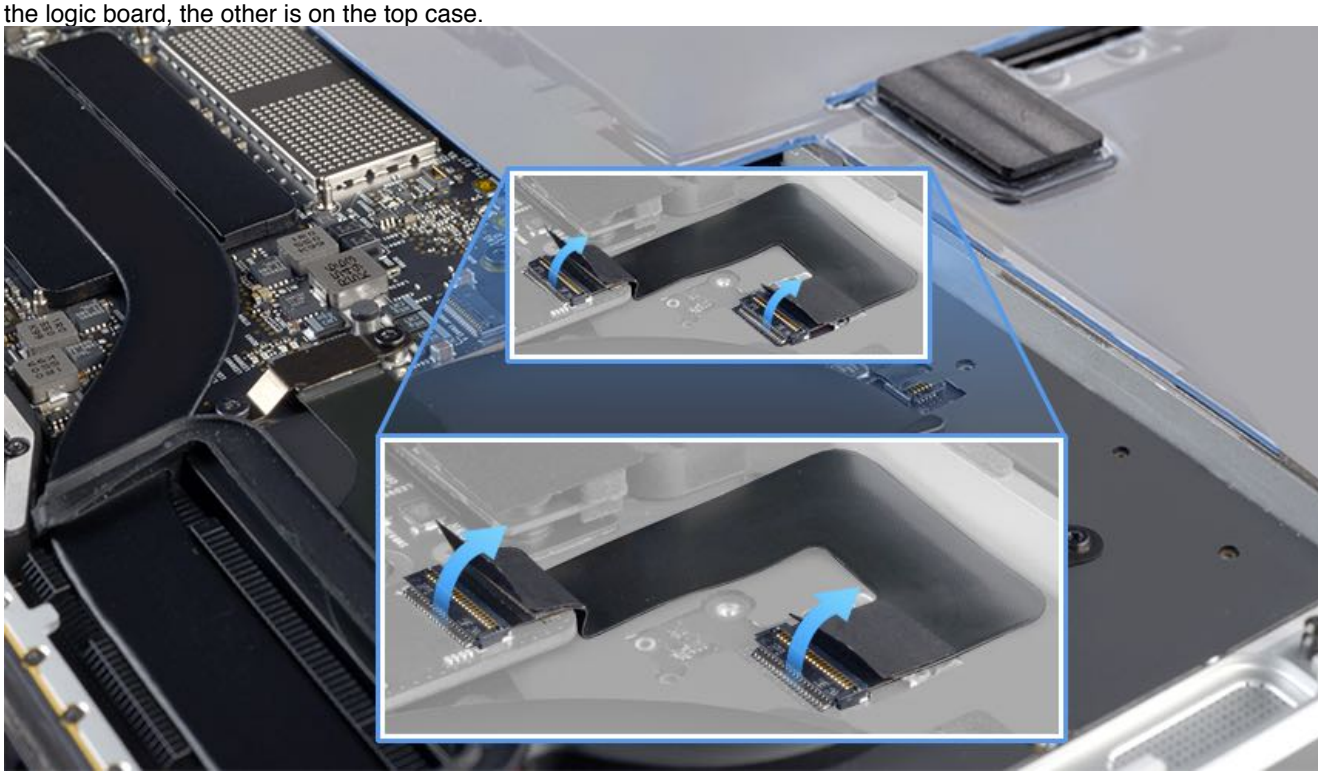


Tools

- ESD strap
- Black stick
- Battery cover (923-01318)

Steps For Removal

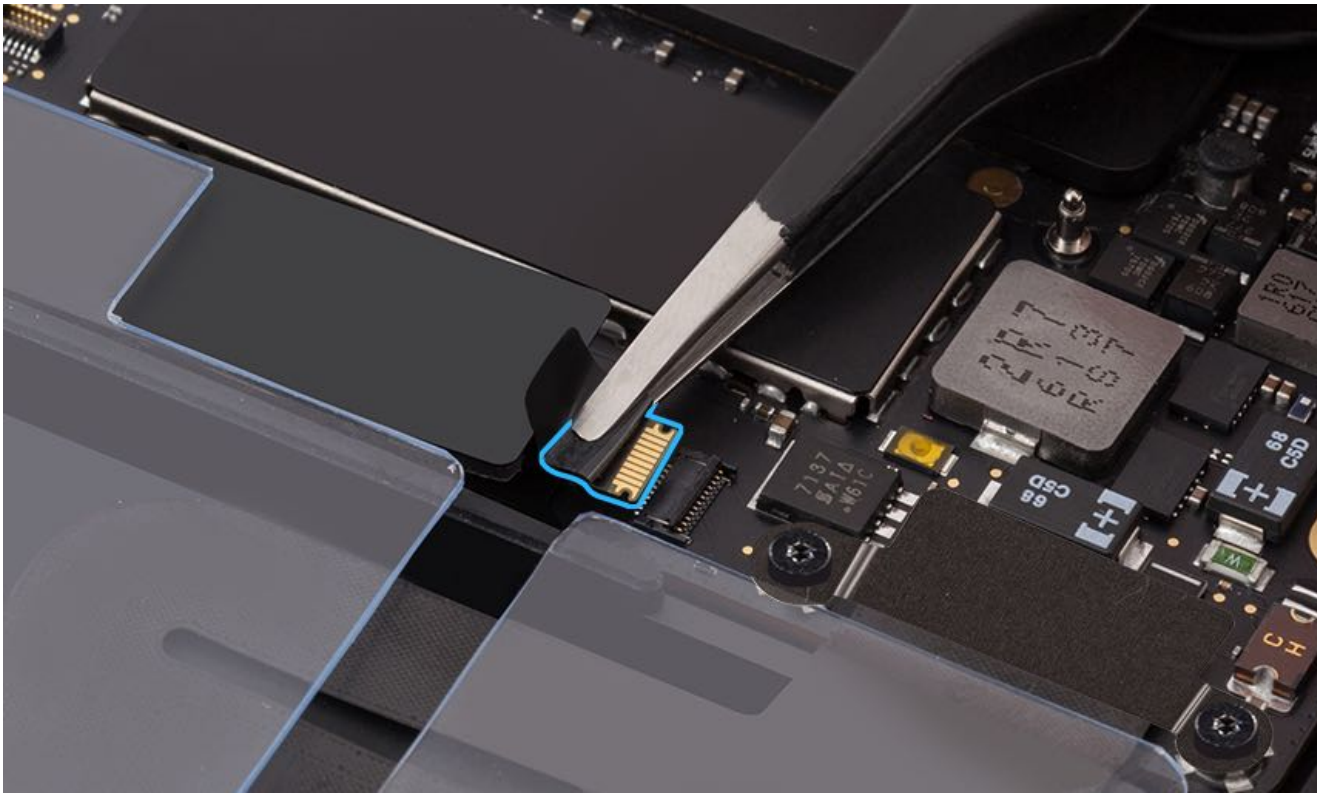
1. Use the flat end of the black stick to lift the locking levers on the keyboard flex cable connectors; one locking lever is on the logic board, the other is on the top case.



2. Use your finger and a black stick to gently ease the flex cable from each connector. Note: The keyboard flex cable is attached to the top case with VHB (very high bond) adhesive. Carefully remove the flexible cable from the top case.

Steps For Reassembly

1. Reconnect the keyboard flex cable. Secure the locking levers, pressing them flat.
2. Reinstall the right speaker and three T5 screws. **Note:** The two short T5 screws are along the left side of the speaker.
3. Reconnect the right speaker flex cable to the logic board. Secure the locking lever, pressing it flat.
4. Reconnect the battery flex cable to the logic board. Secure the locking lever, pressing it flat.



5. Remove the battery cover.
6. Reinstall the bottom case.
7. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
8. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Top Case Assembly with Battery

First Steps

Warning:

- Attach the battery cover and disconnect the battery immediately after removing the bottom case.
- Do not apply external power while the computer is under repair.

Important:

- This procedure should only be performed by Apple-certified technicians. For more information, refer to article HT205332: About AppleCare service certifications.
- Wear an ESD wrist strap and take precautions to avoid ESD.
- Before you begin a repair, disable the auto boot features. Refer to article TP1484: Auto Boot.

Remove:

- Bottom case
- Attach battery cover and disconnect battery
- Speakers
- Flash storage (optional)
- Embedded DisplayPort (eDP) cowlings
- Clutch covers
- TCON board screws
- Vent/antenna module
- Logic board
- Fan
- Keyboard flex cable
- Display assembly

Top Case Assembly with Battery MacBook Pro (13-inch, 2016, Two Thunderbolt 3 Ports)

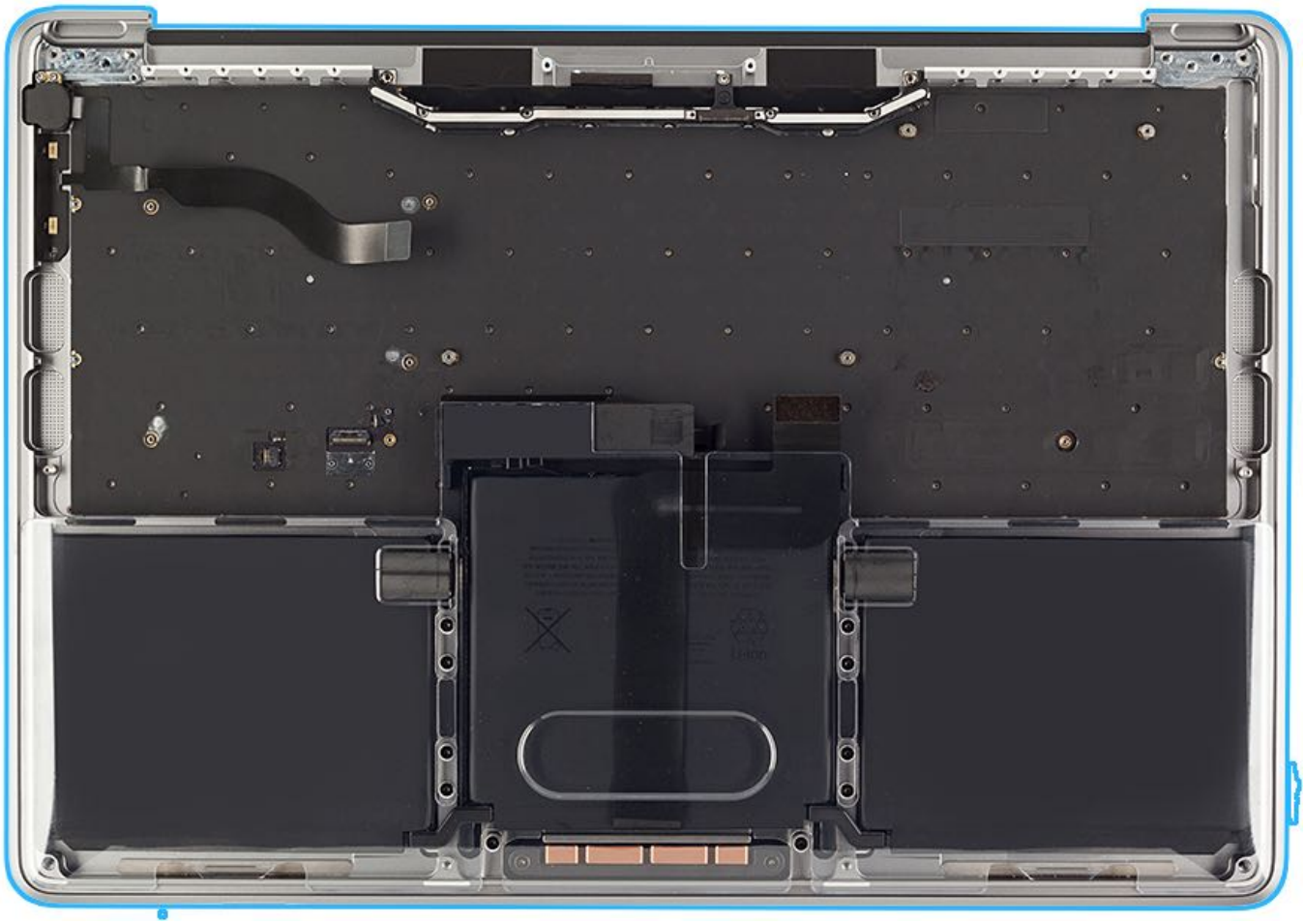
Top Case Assembly with Battery MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports)

Tools

- ESD wrist strap
- Battery cover (923-01318)

Steps For Removal

With all the items listed above removed, the top case is the remaining part. The top case includes the battery, BMU board, BMU flex cable, audio flex cable, microphone, and trackpad flex cable.



Steps For Reassembly

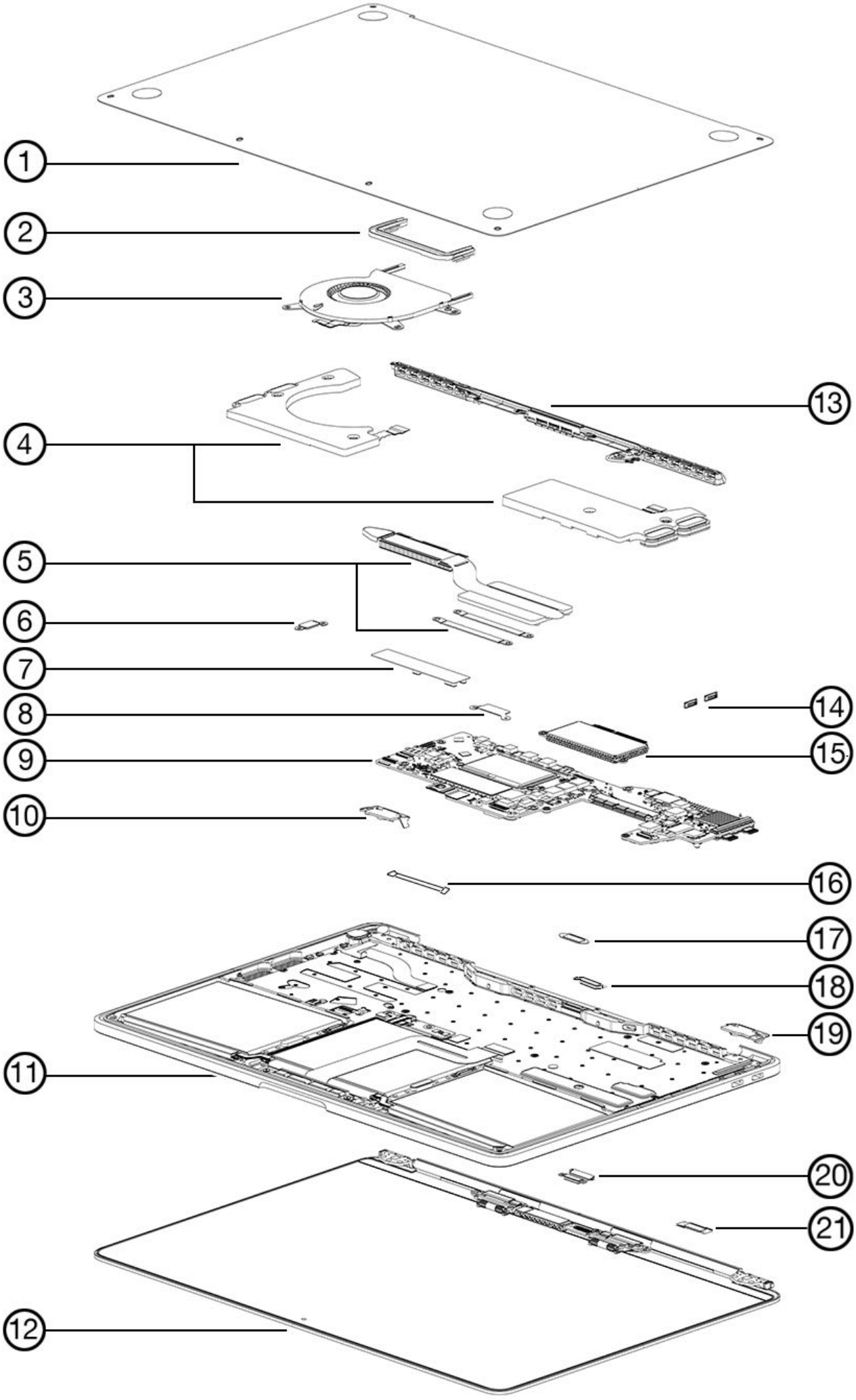
Replacement Note: If replacing the top case, the trackpad flex cable will come with a backer liner covering the adhesive; it will not be pre-attached to the battery pack. Do the following:

- Remove the backer liner.
- Attach the trackpad flex to the logic board connector, ensuring the two 90 degree bends in the trackpad cable are not flexed.
- Activate the adhesive by gently pressing the cable onto the battery. Starting at the logic board end of the cable, press any slack in the cable toward the trackpad actuator (lower edge of top case).
- Make sure the silver, screw standoffs are present on the top case.

1. Reinstall the keyboard flex cable.
2. Reinstall the fan.
3. Reinstall the logic board. (Read the Replacement Note above.)
4. Reinstall the display assembly.
5. Reinstall the vent/antenna module.
6. Reinstall the TCON board.
7. Reconnect the eDP cable to the TCON board and replace the eDP cowlings.
8. Reinstall the clutch covers.
9. Reinstall the flash storage if removed previously.
10. Reinstall the speakers.
11. Reinstall the BMU screw, reconnect the battery cable, and remove the battery cover.
12. Install a new BMU Mylar cover.
13. Reinstall the bottom case.
14. Verify the trackpad performance after every repair. For instructions, refer to article TP1314: Trackpad Calibration Check.
15. Re-enable the auto boot features. Refer to article TP1484: Auto Boot.

Exploded View

Exploded View for MacBook Pro (13-inch, 2016, Two Thunderbolt 3 Ports)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1. Bottom Case

- 923-01128, Space Gray
- 923-01167, Silver

2. Thermal Duct

- 923-01171

3. Fan

- 923-01168

4. Speakers, Left and Right, Pair

- 923-01078

5. Heat Sink, Kit

- 076-00245

6. Cowling, Audio Flex Cable

- 923-01296

7. BMU Mylar Cover

- 923-01450

8. Cowling, Trackpad Flex Cable

- 923-01303

9. Logic Board

- 661-05072, i5, 2.0GHz, 8GB, FCC
- 661-05073, i5, 2.0GHz, 8GB, ETSI
- 661-05074, i5, 2.0GHz, 8GB, ROW
- 661-05076, i5, 2.0GHz, 16GB, FCC
- 661-05077, i5, 2.0GHz, 16GB, ETSI
- 661-05078, i5, 2.0GHz, 16GB, ROW
- 661-05080, i7, 2.4GHz, 8GB, FCC
- 661-05081, i7, 2.4GHz, 8GB, ETSI
- 661-05082, i7, 2.4GHz, 8GB, ROW
- 661-05084, i7, 2.4GHZ, 16GB, FCC
- 661-05085, i7, 2.4GHZ, 16GB, ETSI
- 661-05086, i7, 2.4GHZ, 16GB, ROW

10. Display Clutch Cover, Right

- 923-01445

11. Top Case Assembly (includes battery, keyboard, trackpad, trackpad cable, audio cable, and microphone)

- 661-05114, ANSI, Space Gray
- 661-05115, ANSI, Silver
  Note: Regional top cases have the same part number, but they include a language code prefix. For example, F661-05115 is for France.

12. Display Assembly (includes TCON board and spring tensioner cables)

- 661-05095
- 661-05095

13. Vent/Antenna Module

- 923-01169

14. Gaskets, Thunderbolt 3 Ports, Logic Board

- 923-01172

15. Flash Storage

- 661-05111, 256GB
- 661-05112, 512GB
- 661-05113, 1TB

16. BMU Flex Cable

- 923-01448

17. Cowling, Mylar, eDP Flex Cable (comes with eDP flex cable)

- 923-01288

18. Cowling, eDP Flex, Upper

- 923-01310

19. Clutch Cover, Left

- 923-01446

20. Cable, eDP FLex (comes with Mylar cowling)

- 923-01288

21. Cowling, eDP Flex, Grounding, Lower

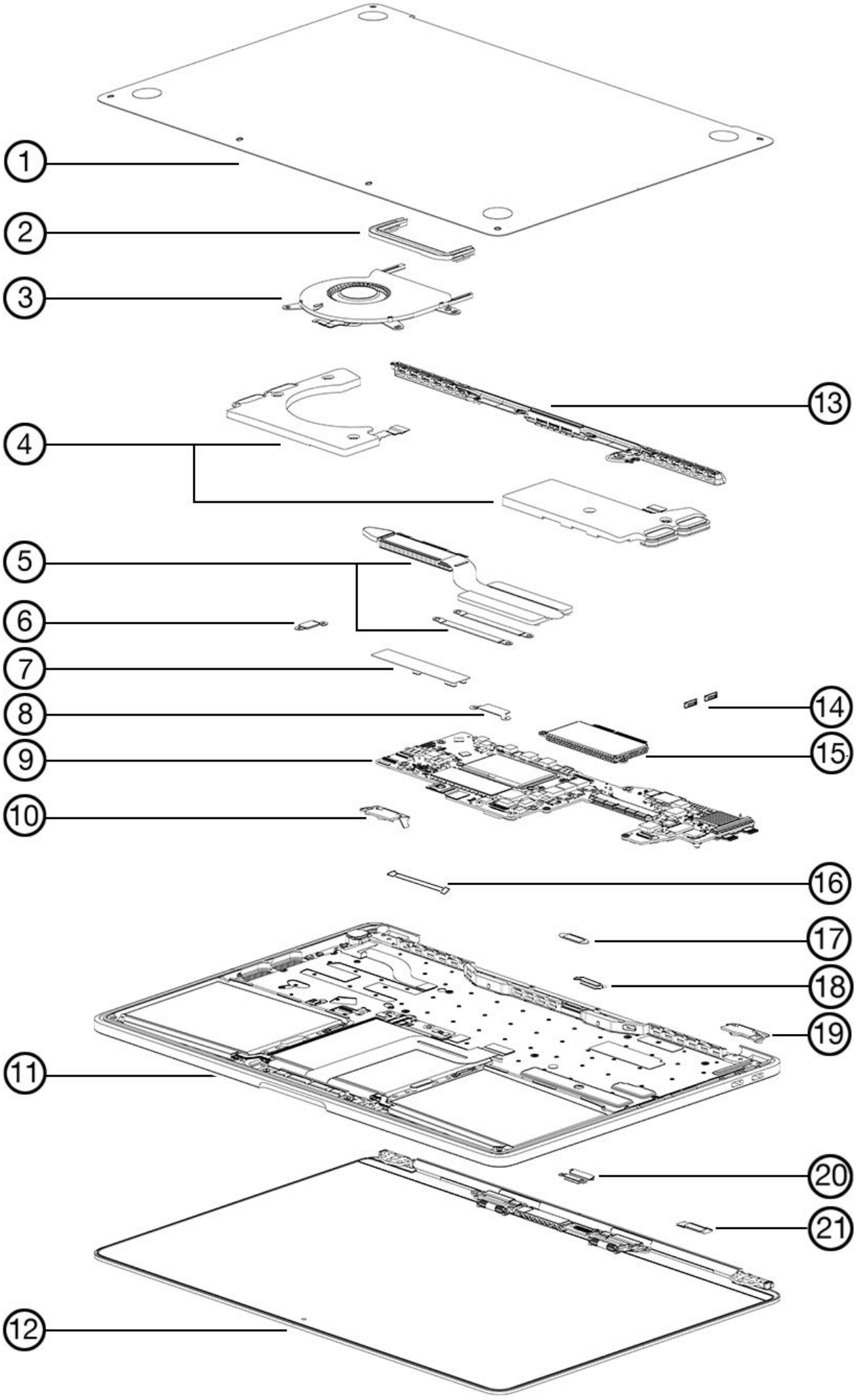
- 923-01308

Not shown:

- 923-01447: Keyboard Flex Cable (keyboard to logic board)

Exploded View

Exploded View for MacBook Pro (13-inch, 2017, Two Thunderbolt 3 Ports)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1. Bottom Case

- 923-01784, Space Gray
- 923-01785, Silver

2. Thermal Duct

- 923-01171

3. Fan

- 923-01168

4. Speakers, Left and Right, Pair

- 923-01078

5. Heat Sink, Kit

- 076-00245

6. Cowling, Audio Flex Cable

- 923-01296

7. BMU Mylar Cover

- 923-01450

8. Cowling, Trackpad Flex Cable

- 923-01303

9. Logic Board

- 661-07568, i5, 2.30GHz, 8GB, FCC
- 661-07569, i5, 2.30GHz, 8GB, ETSI
- 661-07570, i5, 2.30GHz, 8GB, ROW
- 661-07572, i5, 2.30GHz, 16GB, FCC
- 661-07573, i5, 2.30GHz, 16GB, ETSI
- 661-07574, i5, 2.30GHz, 16GB, ROW
- 661-07576, i7, 2.50GHz, 8GB, FCC
- 661-07577, i7, 2.50GHz, 8GB, ETSI
- 661-07578, i7, 2.50GHz, 8GB, ROW
- 661-07580, i7, 2.50GHz, 16GB, FCC
- 661-07581, i7, 2.50GHz, 16GB, ETSI
- 661-07582, i7, 2.50GHz, 16GB, ROW

10. Display Clutch Cover, Right

- 923-01445

11. Top Case Assembly (includes battery, keyboard, trackpad, trackpad cable, audio cable, and microphone)

- 661-07946, ANSI, Space Gray
- 661-07947, ANSI, Silver
  Note: Regional top cases have the same part number, but they include a language code prefix. For example, F661-05115 is for France.

12. Display Assembly (includes TCON board and spring tensioner cables)

- 661-07966, Space Gray
- 661-07967, Silver

13. Vent/Antenna Module

- 923-01169

14. Gaskets, Thunderbolt 3 Ports, Logic Board

- 923-01172

15. Flash Storage

- 661-07584, 128GB
- 661-07585, 256GB
- 661-07586, 512GB
- 661-07587, 1TB

16. BMU Flex Cable

- 923-01448

17. Cowling, Mylar, eDP Flex Cable (comes with eDP flex cable)

- 923-01288

18. Cowling, eDP Flex, Upper

- 923-01310

19. Clutch Cover, Left

- 923-01446

20. Cable, eDP FLex (comes with Mylar cowling)

- 923-01288

21. Cowling, eDP Flex, Grounding, Lower

- 923-01308

Not shown:

- 923-01447: Keyboard Flex Cable (keyboard to logic board)

Screw Chart

Screw Chart for MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)

923-01095 Pentalobe  Bottom Case, Lower, Center, Space Gray, (2)	**923-01299** Pentalobe  Bottom Case, Back Corners, Space Gray, (2)	**923-01097** Pentalobe  Bottom Case, Front Corners, Space Gray, (2)
923-01098 Pentalobe  Bottom Case, Lower, Center, Silver (2)	**923-01099** Pentalobe  Bottom Case, Back Corners, Silver (2)	**923-01100** Pentalobe  Bottom Case, Front Corners, Silver (2)
923-01286 Torx T3  Display Clutch Covers (4)	**923-01173** Torx T8  Display Clutch to Top Case (6)	**923-01185** Torx T3  Spring Tensioners (4)
923-01178 Torx T5  Speaker, Right, Long (1) Speaker, Left, Long (2)	**923-01179** Torx T5  Speakers, Right, Short (1)	**923-01182** Torx T5  Flash Storage (2)

923-01191
1IPR

Vent/Antenna Module (12)

923-01184
Torx T5

Antenna (1)

923-01282
Torx T5

TCON, Shoulder, Outer Screw (2)

923-01277
Torx T5

TCON, Inner Screw (2)
Cowling, Audio Flex Cable, Upper Screw (1)

923-01285
Torx T3

Cowling, eDP Flex Cable, Upper Cowling (2)

923-01284
Torx T3

Cowling, eDP Flex Cable, Lower Cowling (2)

923-01174
Torx T5

Fan (4)

923-01176
Torx T5

Logic Board, Thermal Tie Down (1)

923-01177
Torx T5

Cowling, Audio Flex Cable, Lower Screw (1)

923-01190
Torx T3

eDP to Logic Board (2)

923-01189
Torx T5

BMU Screw (1)

923-01276
Torx T5

Heat Sink Springs (4)

923-01281 Torx T5  Cowling, Trackpad Flex Cable (2)	**923-01180** Torx T5  Logic Board (3)	**923-01302** Hex Driver  Speaker Standoff

External Views

External Views of MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports)

Front View

Note: The keyboard is slightly different on the 2017 model. Refer to article RP1296: Top Case Assembly with Battery.

Port View

A = Headphone Jack
B = Two Thunderbolt 3 Ports

Bottom Case

The system serial number and model number are located on the bottom case. Turn over the computer to view the numbers etched on the bottom case near the hinge.

Model Numbers
MacBook Pro (13-inch, 2016 and 2017, Two Thunderbolt 3 Ports): **A1708**

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